THE PEDAGOGICAL SEMINARY AND

JOURNAL OF GENETIC PSYCHOLOGY

Child Behavior, Animal Behavior, and Comparative Psychology

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VOLUME 58

1941

Copyright, 1941, The Journal Press

Published quarterly by The Journal Press
Provincetown, Massachusetts, U S A

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EDITED BY

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THE JOURNAL PRESS
2 Commercial Street
Provincetown, Massachusetts
U. S. A.

$7 00 per volume
Single numbers $4 00

Two volumes per year
QUARTERLY

March, 1941
Volume 58, First Half

Founded by G Stanley Hall in 1891

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(over)

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Provincetown, Massachusetts
Entered as second-class matter, August 3, 1897, at the post-office at Worcester, Mass , under the Act of March 3, 1879
Reentered as second-class matter May 11, 1937, at the post-office at Provincetown, Mass , under the Act of March 3, 1879

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The Journal of Genetic Psychology, 1941, 58, 3-26.

MEASUREMENT OF DYNAMIC ASPECTS OF BEHAVIOR AMONG ADOLESCENTS*[1]

Progressive Education Association

THEODORA M. ABEL

A PROBLEM

The psychotechnical methods employed most extensively in schools today are limited in their measurement of psychological functioning These tests give some indication in terms of relative scores and ranking in the school population of the products of some aspects of behavior, solving problems, remembering, imagining, and understanding They do not, however, tell us about differences in dynamic aspects of behavior Two students may obtain the same scores on a test but yet one is perseverative and finds it hard to turn from one type of problem to another, while the other may be so facile in shifting from one task to another or so unconcerned about leaving a problem unsolved that he rips along through a test with the greatest of ease. For purposes of selection, classification and adjustment of students in the school situation, measurement of conative as well as cognitive modes of psychological functioning is indicated

Personal data questionnaires and psycho-neurotic inventories reveal something about these dynamic aspects; whether an individual worries about his work, whether he can concentrate or is distractable These questionnaires, however, do not give scores for behavior in the actual situations under question, but rather show what students say they do or might do That there may be some relationship between an *S*'s opinion of himself and how he actually behaves in concrete situations is no doubt true, but the relationship may be either diminished or increased depending upon the dynamic influences at work at the time *S* is answering the questions. It was rather the measurement of some of these dynamic influences that are present when an *S* thinks, with which we were concerned.

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*Received in the Editorial Office on September 24, 1939

[1] This study was carried on during 1935-36 for the Committee on Study of Adolescents, Commission on Secondary School Curriculum, Progressive Education Association, while the author had a fellowship under the General Education Board

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The Downey *Will Temperament Tests* made an attempt to measure conative aspects of behavior: persistence, freedom from load, flexibility. Their use has been limited because of the difficulty of ascertaining whether or not the tests measure the volitional characteristic designated. Furthermore, we ruled out these tests as they did not sufficiently provide conditions equivalent to an intelligence or achievement test where the *S*'s have to do some thinking out of problems, more so than in the easy tasks required by Downey, but, nevertheless, where it would be possible to measure conative aspects of behavior.

Lewin and his associates have developed techniques for measuring the dynamics of behavior, which meet the objections we found to the Downey tests (4). Lewin has assumed that in doing a task tensions are created in an organism and these tensions may be released in various ways (through memorial recall, carrying out a substitute task, etc.). It is the measurement of the release of these tensions with which Lewin was concerned. For instance, Zeigarnik and he found that unfinished goal-determined tasks may set up a tension in the organism that persists regardless of the external necessity or relevancy of finishing the task (11). If *S*'s are presented with a series of tasks some of which they are allowed to finish, while others they are prevented from so doing, and are subsequently told to recall the tasks they have performed, they remember on the average almost twice as many unfinished as finished tasks. But also, many individual differences in response occur. Younger children and more naive and ambitious adults recall more unfinished tasks, while more sophisticated or indifferent adults and fatigued individuals recall more completed tasks. Various other investigators have corroborated these results (Pachauri, 8; Rosenzweig and Mason, 9).

Another line of procedure worked out by Lewin and his collaborators has been the conditions under which an *S* returns to an interrupted task, or those under which a substitute task can drain off the tension set up by an original task that *S* is not allowed to carry out (Katz, 3, Lissner, 5, Ovsiankina, 7). But the technique of recalling completed and interrupted tasks seemed to us to be the one that could be best adapted for use among adolescents in school, because the method could be employed in groups, could be carried on within a reasonable time limit, did not require any elaborate equipment, but did reveal individual differences as well as group trends.

B PROCEDURE

On the basis of suggestions offered and difficulties encountered by other investigators we devised a series of tasks that met the following requirements:[2]

1 Paper and pencil, each one of which could be presented on one sheet of paper (The disadvantage of more elaborate equipment can readily be seen in giving group tests)

2 Taken seriously by adolescents (*CA* 15-20) [Lack of incentive and indifference reduces tension for unfinished work Brown (2), Marrow (6)]

3 Not too interesting (Interesting tasks are recalled too readily regardless of whether they are completed or not)

4 Understood immediately by all *S*'s (To minimize time required for explanations)

5 Short

6 Not too difficult so that most of the *S*'s could finish in the allotted time, but yet not too easy so that there would be some necessity for application

7 Definitely goal-determined in the sense that the final answer could not be obtained until the whole task was completed, but yet where the goal was clear cut

8 Varied, non-verbal and verbal, and covering different fields of interest (sports, games, drawing), covering different school subjects (arithmetic, algebra, and social science), and requiring different modes of thinking for their solution (logical and imaginative)

9 Suitable for both sexes

Eighteen tasks were selected after several preliminary trials Unfortunately, because of the time limit of 45'-50', a school period allowed for testing, it was not possible to have 20-22 tasks, the number which other investigators have found suitable. The tasks were·

1 Writing a given sentence twice in disguised handwriting.

2 *Arithmetic problem*

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[2] Thanks are due Professor Max Wertheimer of the New School for Social Research for valuable suggestions concerning the selection and administering of tasks

3 Concocting a 10-word telegram calling members of a club to a meeting

4 Proofreading a paragraph presented with spelling errors

5 Choosing the quickest route to travel between two cities where changing trains at junctions was required Time tables given.

6. Finding three words, name of author, city and river, all beginning with the same letter and each word not having more than six letters

7 Two columns of figures to be added to find which column has the largest sum

8. Two sentences in artificial language with vocabulary given To be translated to see whether these sentences contradict each other in meaning or not

9. Two simple algebra equations to solve and find out whether the proportion of the first to the second is greater or less than 4/6.

10 Choosing between having a trial by judge or jury in an automobile accident (driver innocent). Reasons for the choice to be given.

11 Paraphrasing a six-line poem.

12 Connecting by straight lines numbers scattered over the page in random order Numbers to be connected in sequence (1-30).

13 Completion test Filling in blanks in a paragraph

14 Making a symmetrical design in a rectangle using 19 straight and six curved lines

15 Four words given. Required to make three sentences with different meanings using all four words in each

16 Arithmetic problem.

17 Opposites test

18 Floor plan of school building given The itinerary of two pupils sent on various errands around the school is presented The problem is to decide whether pupil *A* or *B* has to go the greatest distance.

At a signal, the first paper was turned over and *S*'s were given directions for the first task At a second signal, *S*'s started work On the tasks that were to be completed, *S*'s were allowed to work for three minutes (most of them had finished by then) and were then told, "*That will be all Put your papers in the folder We shall now turn over the next paper.*" We then began to explain the directions for the second task The same instructions were given for the tasks that were cut off at 30 seconds We made no comment about not giving more time We merely said that we had to turn to the next task We always made sure that a task that was not to be worked on any more was placed in the folder provided, so that *S* could not see this task again nor refresh his memory.

The order of presenting the tasks remained the same throughout the experimenting (Nos. 1-18 as we have described). Two variables, however, were introduced in the test procedure, the first was the presentation of a task as completed or interrupted (Series *A* and *B*), the second was the type of instruction given as to the reason for administering the tests (Motivation I and II)

In order to increase the tension for finishing tasks, we had all *S*'s always complete Tasks 1 and 2 We hoped thus to give them the feeling that the tasks were to be completed. Of the next 16 tasks, eight were always completed and eight were interrupted. In Series *A* the *S*'s completed Nos. 1, 2, 3, 5, 8, 9, 11, 14, 16, 18, and were interrupted on the other tasks In Series *B* the *S*'s completed Nos. 1, 2, 4, 6, 7, 10, 12, 13, 15, 17, and were interrupted on the other eight tasks Approximately one-half of the *S*'s were included in each of the series.

A good deal of work has been done by other investigators on the influence of motivation on the recall of tasks. Rosenzweig told one group of adults that the tasks (puzzles) he was presenting them with, were being given as an intelligence test, to another equivalent group, he made the motivation much more informal saying the puzzles were to be done only as a help to the experimenter in classifying them for future use (9). The former group, who took the task as a test, recalled more completed tasks, while the latter recalled more unfinished tasks Rosenzweig felt that either pride or excitement caused the greater recall of finished tasks for the first group Marrow studied the effects of encouragement and discouragement (6) He found that both these incentives were more effective in producing more tension for unfinished tasks than was the incentive of indifference given a control group. Zeigarnik showed that interest in the task per se regardless of score produced a greater recall of incompleted work, while predominant interest in obtaining a rating had the opposite effect, bringing about greater recall for completed work (11).

We gave two types of instruction in order to study some of the differences in motivation suggested by these investigators Under Motivation I we stressed competition (a typical test procedure), telling the *S*'s they would be presented with a series of new and interesting tasks, and that the purpose of the test was to see whether students in different schools around New York did as well, if not better, than freshmen in college They were told to do as well as they could Under Motivation II the instructions were radically changed in order to try to eliminate the idea of competing in a test situation The *S*'s were told that they were participating in a kind of psychological experiment We said

> I am going to give you several tasks to do, but the purpose of these tasks has nothing to do with any individual score you make, with how well you succeed in doing the problems given I am interested in finding out the ways in which you all handle different problems, and the attitudes you take toward them, and not at all in individual differences in success and failure

We hoped in this way to have the *S*'s become interested in the tasks per se regardless of the outcome and to compare these results with those under Motivation I

1. *Recall Procedure*

When the tasks were finished under both Motivation I and II, the experimenter said that that was the end of the test, but that before leaving she would like the *S*'s to do one more thing, just a little stunt that was only for the benefit of the experimenter herself and would not be handed in with the test material The *S*'s did not have to put their names on this sheet (later identified by means of the handwriting) After conversing informally with the *S*'s for one or two minutes to get them away from a test atmosphere, the experimenter handed them a sheet of paper, and told them to write down the names of the tasks they had done in the order in which they came into their heads They were told to draw a line under the last name they wrote before they hesitated and stopped to think This we did as Zeigarnik had found that the fluent recall before hesitancy was the more important part of the tension recalls of unfinished tasks Under Motivation II we next asked the *S*'s to write down any comments they wanted to make about the tests, what they thought about them, and what attitudes they had while doing them. This was also to be informal and as a help to the experimenter

2 *Subjects*

Under Motivation I there were 206 high school students, 101 in Grade 10, 81 in Grade 11, and 24 in Grade 12. The schools participating in the study were the Fieldston, Brearley, and Chapin schools in New York City Under Motivation II there were 71 high school students, in Grade 10 at the Bronxville high school and in Friends' Seminary, New York City, and 66 college freshmen at Sarah Lawrence College, Bronxville, and Pratt Institute, Brooklyn.[3] The groups given the test by Series *A* and *B* (order of presenting tasks as completed or interrupted) were approximately equal for each class, school, and college The groups were limited to 10-15 *S*'s each The author acted as experimenter throughout.

3. *Method of Scoring*

Our first method of scoring was an adaptation of the one used by Rosenzweig and Mason (10) We found the per cent recall of interrupted (*I*) and completed (*C*) tasks, and employed these per cents in obtaining differences between the *I* and *C* tasks If the difference (*I*-*C*) is positive then a greater number of *I* than *C* tasks are recalled If the difference is negative, the opposite is true A score of zero means that an equal number of *I* and *C* tasks have been recalled

Other methods of scoring will be explained as they are employed later on in this study.

C. RESULTS

Our results are presented in two sections, Section 1 contains comparisons of Series *A* and *B* (order of presenting tasks as completed or interrupted), time of presenting tests (whether *S*'s taking the test earlier influenced those doing so subsequently), Motivation I and II (as test or psychological experiment), different schools and colleges, and sexes Section 2 contains comparisons of subgroups, those recalling more *I* or *C* tasks or an equal number of each, and discusses the significance of these differences as expressions of differences in dynamic aspects of behavior.

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[3] Thanks are due the principals of these schools, and Dr Elizabeth Duffy of Sarah Lawrence College, and Dr Alice Bryan of Pratt Institute for their kind cooperation in this study

1. *Groups*

a Series A and B (order of presenting tasks as completed or interrupted) In spite of having tried to eliminate in preliminary trials, tasks that were so interesting that they were recalled by all groups regardless of whether they were interrupted or finished, there were two tasks that were still recalled most of the time (79 to 100 per cent). These tasks were No. 14 (making a symmetrical design) and No. 18 (floor plan of school)[4] Making the design caused a good deal of excitement and interest on the part of some groups, either because it was different and fun, or because it caused embarrassment (the *S* felt he was no artist!) No 18 was the last task and was remembered because of the recency factor.[5] Consequently, we eliminated these two tasks from the scoring. In giving the results below we are using only the recall of 14 tasks (Nos. 3-13, 15-17) Tasks 1 and 2 were considered preliminary as we have previously stated.

TABLE 1

SHOWING SCORES IN SERIES *A* AND *B* AND UNDER MOTIVATION I AND II

Motiv	Ser	Group	Grade	No *S*'s	(Differences (*I-C*)) *M*	*Q*1	*Q*3
I	*A*	Fieldston	10	35	+10	—19.71	+33.13
I	*B*	Fieldston	10	42	— 4.46	—21.25	+10.20
I	*A*	Fieldston	11	42	+ 8.43	—12.21	+30.93
I	*B*	Fieldston	11	36	0	—24.75	+23.85
II	*A*	Bronxville and Friends' Sem	10	35	+ 5.25	—10.88	+16.25
II	*B*	Bronxville and Friends' Sem	10	35	+ 5.25	— 7	+21.66
II	*A*	Sarah Lawrence and Pratt	Freshman	35	— 3.45	—23.67	+14.50
II	*B*	Sarah Lawrence and Pratt	Freshmen	31	— 1.44	—18.09	+11.58

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[4] We are not including the frequencies of recall for all tasks because of space limitations

[5] If the recall of tasks could have been delayed four or five minutes after the completion of Task 18, the recency factor could have been reduced This was not possible because of the time limitation of the testing period

Table 1 shows the medians and quartiles of the difference scores (*I-C*) in Series *A* and *B* (the Brearley and Chapin groups are not included in these comparisons). As can be seen from these data, there are no appreciable differences between Series *A* and *B* except in the case of the two Fieldston classes (10 and 11), where Series *A* favors the recall of interrupted (*I*) tasks more than does Series *B*. But these differences are not reliable statistically. By the *A* series the *ave diff* score (*I-C*) for Classes 10 and 11 combined is +5.32, *PE* 20.13, and by the *B* series it is —4.34, *PE* 19.30. The actual *diff.* in *ave* score is 9.66, PE_{diff} 3.16 *CR* 3.05 In view of the similarity of results of the two series, we grouped the results for Series *A* and *B* in our next comparisons

b. Time of giving tests. As the tests at Fieldston were given to fairly large groups in two successive weeks, we looked for a possible difference in performance between the first and second weeks. *S*'s tested in the second week had opportunity to profit from information obtained from *S*'s tested the first week, although we tried to give the impression that the recall task was not part of the testing Three groups in Grade 10 (two groups by Series *A* and one by *B*) and three groups in Grade 11 (two by Series *B*, one by *A*) were tested the first week, and the same number of groups were tested the second week (two groups by Series *B*, one by *A* in Grade 10, two by Series *A*, one by *B* in Grade 11). The *I* minus *C* scores were (Table A).

TABLE A

	No *S*'s	Ave	*PE*
First week	79	—2.06	20.83
Second week	76	+1.06	19.09

The results were about the same for the two weeks In fact, *the second week slightly favored the plus scores, which is not what* would have been expected if the students had "learned" something about the nature of the experiment Furthermore, if *S*'s taking the test the second week had been told about the different tasks and about the recall task in particular, their memory span for the number of items recalled might have been larger than for the students who took the test earlier This was not the case, as we found by obtaining the number of recalls for the first and second weeks, all of which averaged 8 or 9 *c. Motivation I and II* (test or psychological experiment) No differences were found in the frequency of recall for *I* or *C* tasks under the two types of motivation (Table 3) Our results are contrary to those of Rosenzweig (9) But we were dealing with *S*'s who had all taken frequent tests of intelligence or scholastic aptitude. To them our experiment was just one more test, part of the routine. In spite of instructions to the contrary under Motivation *II*, they took the tasks as a test *We can assume that their* predominant attitudes were not conducive to participating actively in the tasks for their own sake but rather of obtaining a score or rating.

d Grades, schools and colleges Before presenting the comparative data on the recall of *I* and *C* tasks, we shall give the memory span for the different groups tested regardless of whether the tasks were completed or not. We added up the total number of recalls (not including the recall of the first two tasks) The results are shown in Table 2 The differences in the number of recalls for the different groups are negligible except in the case of the Brearley group whose *ave.* memory span was greater than that of any other group (difference reliable statistically). The Brearley School consisted of a highly selected group of girls, all of whom had exceptionally high scores on the American Council Tests The memory span for all other groups being practically equal, makes the results for the recall of *I* or *C* tasks the more comparable

TABLE 2

SHOWING AVE NO RECALLS FOR DIFFERENT GROUPS AND MEASURES OF VARIABILITY

Motiv.	Group	Grade	No *S*'s	Range	No. recalls Ave	*PI*
I	Fieldston	10	78	3-15	8.65	1.61
I	Fieldston	11	81	5-14	9.35	1.15
I	Brearley	10, 12	38	9-14	11.13	.89
I	Chapin	12	9	7-14	9.94	1.24
II	Bronxville	10	50	5-14	8.66	1.53
II	Friends' Sem	10	21	3-14	9.69	1.71
II	Sarah Law	Freshman	40	7-14	10.3	.89
II	Pratt	Freshman	26	5-14	9.35	1.54

Table 3 gives the difference scores (*I-C*) for the groups tested The scores for the two girls' schools under Motivation I were

TABLE 3

SHOWING SCORES, SERIES *A* AND *B* COMBINED, FOR DIFFERENT SCHOOLS, COLLEGES AND GRADES UNDER MOTIVATION I AND II

Motiv	Group	Grade	No *S*'s	Difference scores (*I*-*C*) Ave	*PE*
I	Fieldston	10	77	+ .31	19.0
I	Fieldston	11	78	+ .64	19.23
I	Brearley Chapin	10, 12 12	47	+2.68	17.87
II	Bronxville Friends' Sem	10	70	+4.21	16.98
II	Sarah Law Pratt	Freshman	66	—3.66	14.85

thrown together as were those for the two schools and two colleges in Motivation II as no appreciable differences were found between these groups. Comparing these averages, we see that there are no outstanding differences among the groups. The only noticeable difference lies between the colleges and the various school groups. Both college groups recalled more completed (*C*) tasks than did the school groups. This difference, however, is not reliable statistically. If we compare the difference in average between the colleges and the group showing the greatest contrast to them (Bronxville 10 and Friends' Sem. 10), we find the actual difference in average 7.87, and the PE_{diff} 2.72 which gives a *CR* of only 2.89. Nevertheless, there was at least a tendency on the part of the college students to recall more completed tasks than did the school groups. This difference will be brought out more clearly in our next comparisons.

This time we employed as scores the percentage recall for *I* and *C* tasks separately, instead of the difference between *I* and *C*. Table 4 shows first the percentage recall for *I* then for *C* tasks for the different groups. These results indicate that the college students recall approximately the same percentage of *I* tasks as do the other groups but recall more *C* tasks. The Brearley-Chapin group was excluded from these comparisons for, as we have already mentioned, the Brearley girls who formed the decided majority of this group (38 out of 47) recalled on the average two more tasks than did any other group, school or college, so that their percentage recalls for both *I* and *C* tasks are higher than are those of the other groups

TABLE 4

Showing Percentage Recall for Interrupted (*I*) and Completed (*C*) Tasks for the Different Groups

Group	No *S*'s	Percentage recall *I* tasks Ave.	Percentage recall *I* tasks *PE*	Percentage recall *C* tasks Ave	Percentage recall *C* tasks *PE*
Fieldston 10	77	49.50	15.66	50.0	14.27
Fieldston 11	78	55.88	15.60	54.1	12.65
Bronxville 10 Friends' Sem. 10	70	53.70	15.31	51.42	13.75
Sarah Law Pratt	66	58.40	12.24	62.14	10.47

Showing Measures of Reliability of Differences (Coll.—Sarah Law. and Pratt)

Groups	Actual *Diff*	Percentage recall *I* tasks PE_{diff}	*CR*	Actual *Diff*	Percentage recall *C* tasks PE_{diff}	*CR*
Coll. and Fieldston 10	8.9	2.33	3.81	12.14	2.07	5.86
Coll. and Fieldston 11	2.52	2.32	1.08	8.04	1.93	4.17
Coll. and Bronxville-Friends' Sem	4.7	2.38	1.97	10.72	2.08	5.14

If we compare the percentage recall for *I* tasks of the college students with those of any of the other groups, we find no difference that is entirely reliable statistically (Table 4). On the other hand, when we compare the percentage recalls for *C* tasks, all the differences are reliable statistically as can be seen from the table. These results further corroborate the fact that the college students had a relatively greater recall for *C* than for *I* tasks in comparison with the school groups.

Other investigators found differences at various age levels. In general, younger children recall more unfinished tasks than do older ones (10, 11). Furthermore, Rosenzweig reported that older *S*'s have more pride and consequently repress memory for unfinished tasks, while they boasted of recalling tasks satisfactorily completed. Our college students seemed, in general, worried about not doing the job well (many of them had not had algebra in quite a while), so that the factor of pride may well have been stronger with them than with the younger *S*'s.

e. Sex. We compared the performance of the boys and girls in the mixed groups, Fieldston and Bronxville (at Friends' Sem and Pratt there was a very small number of boys but too small a number to make sex comparisons) The average difference score (*I-C*) for 127 girls in Fieldston and Bronxville was +4.4 *PE* 16.5, and for 76 boys it was —4.77 *PE* 18.21. The actual difference in ave score is 9.17, PE_{diff} 2.53, and critical ratio 3.62. This difference is not entirely reliable statistically (99 per cent reliable), but it shows a marked tendency for the girls to have plus scores and the boys to have minus scores

We also looked for differences in percentage recall of *I* and *C* tasks separately. We found the boys performed differently from the college students The latter, as we have shown, recalled more *C* tasks than did the school *S*'s The boys did not recall more *C* tasks, but rather the girls recalled many more *I* tasks than did the boys (Table 5) As can be seen from the table, the difference between the recall of *I* tasks is statistically reliable The girls also recall on the average more *C* tasks than do the boys, but the difference here is less and not statistically reliable.

TABLE 5

SHOWING SEX DIFFERENCES IN PERCENTAGE RECALL OF *I* AND *C* TASKS

Sex	No *S*'s	Ave	*PE*	Actual *Diff.*	PE_{diff}	*CR*
		1 *Percentage recall of I tasks*				
Boys	76	43.16	14.27	15.34	2.21	6.94
Girls	127	58.50	15.49			
		2 *Percentage recall of C tasks*				
Boys	76	46.58	14.72	6.88	1.99	3.45
Girls	127	53.46	12.1[illegible]			

These differences between the sexes were not due to differences in *CA*, intelligence, or distribution in groups given Series *A* or *B* and Motivation I and II We checked these factors If the boys had recalled more *C* tasks, as did the college students, we could conclude that pride or some equivalent attitude influenced their behavior more than it did the girls. But this was not the case Rather, the girls recalled more *I* tasks It would appear then that the girls participated more actively in the task situation, and consequently developed greater tension for unfinished performance than did the boys.

In his study, Pachauri found no sex differences between boys and girls in the recall of *I* or *C* tasks (8, p. 111). He gave a series of tasks to 80 boys and girls in England, ages 13 and 14 He found the mean quotient (unfinished divided by finished) was 1 84 for the girls and 2 for the boys. He did not refer to differences in the frequency of recall of *I* and *C* tasks considered separately Zeigarnik mentioned the fact that a task that was not particularly suited to one sex did bring out differences in recall For instance, she employed a crocheting task which girls recalled if unfinished. The boys felt stupid doing this task and consequently seemed to forget it during the recall period Our study had tried to obviate this factor of interest

2 *Subgroups*

We have been considering so far measurements of central tendency which do not necessarily give us an adequate picture of individual differences in performance within a group It is the individual or subgroup differences that are of particular interest if tests are to be developed for studying the dynamics of behavior Consequently, we have made comparisons of the subgroups representing the extremes in the total distribution, comparing the performance of *S*'s who recalled predominantly interrupted (*I*) tasks, those who recalled predominantly completed (*C*) tasks and those who recalled an equal number of *I* and *C* tasks

a Initial recall of tasks. Zeigarnik first suggested that the tension for unfinished tasks was greater initially in the recall situation, so that the first tasks recalled were *I* tasks As this tension was released through recall, the later recalled items were more likely due to a memory task pure and simple Zeigarnik suggested a method of revealing the tension for recall of unfinished tasks. She found that if she scored only the items recalled by *S*'s before they hesitated, the number of recalls for *I* tasks, in proportion to the number of recalls for *C* tasks, was increased by 10 per cent. Contrarily, if the recall of completed tasks is due to pride and desire to repeat successes as suggested by Rosenzweig, it would seem likely that the *S*'s who recalled a greater number of *C* tasks and repressed the recall of *I* tasks would recall *C* items initially. Zeigarnik did not mention this possibility.

We had asked our *S*'s to draw a line under the last item recalled before they hesitated and had to stop to think, as suggested by Zeigarnik. Since many of our *S*'s forgot to do this, we worked only with the two initial recalls. We first took our largest group of *S*'s (Fieldston, Grades 10 and 11) and divided them into three subgroups, which we shall call High (*H*), Middle (*M*), and Low (*L*). The *H* subgroup recalled the greatest number of *I* tasks, their difference scores (*I-C*) were +16 or more. The *M* subgroup recalled a more equal number of *I* and *C* tasks; their difference scores fell between +15 and —15. The *L* subgroup recalled *C* tasks more frequently, their difference scores were —16 or more. We counted the number of times the two initial recalls were both *I* or *C* for these three subgroups (Table 6). As can be seen the tension for recall

TABLE 6

SHOWING FREQUENCIES OF TWO INITIAL RECALLS FOR *I* AND *C* TASKS FOR DIFFERENT GROUPS AND SUBGROUPS

[For Fieldston subgroups, High has difference score (*I-C*) +16 or more, Low —16 or more; for subgroups of other schools and colleges, High has difference score > 1, Low<1.]

Group	Subgroup	No. *S*'s	Two initial tasks	Recalls No.	%
Fieldston 10, 11	High	47	*I*	25	53
Fieldston 10, 11	High		*C*	5	11
Fieldston 10, 11	Middle	54	*I*	9	17
Fieldston 10, 11	Middle		*C*	17	32
Fieldston 10, 11	Low	44	*I*	6	14
Fieldston 10, 11	Low		*C*	24	56
{Brearley 10,12 {Chapin 12	High	17	*I*	3	18
Chapin 12	High		*C*	3	18
Chapin 12	Low	25	*I*	1	04
Chapin 12	Low		*C*	11	44
{Bronxville 10 {Friends' Sem. 10	High	32	*I*	12	38
Friends' Sem. 10	High		*C*	6	19
Friends' Sem. 10	Low	26	*I*	1	04
Friends' Sem. 10	Low		*C*	13	50
{Sarah Lawrence {Pratt Freshmen	High	24	*I*	3	13
Pratt Freshmen	High		*C*	6	25
Pratt Freshmen	Low	38	*I*	1	03
Pratt Freshmen	Low		*C*	14	37

of *I* tasks was very marked for the *H* subgroup, over 50 per cent recalled two *I* tasks initially, whereas the exact reverse is true for the *L* subgroup, over 50 per cent recalled two *C* tasks initially. The

M subgroup reacted more as did the *L* subgroup recalling initially two *C* tasks more often than two *I* tasks (in the proportion 2:1) If we compare the results for the High and Low subgroups, we find the association between type of initial recall and difference score (*I-C*) entirely reliable by the Chi-Square method ($X^2 = 24.09$ $P < .01$).

We employed the same procedure for our other groups of *S*'s, but as the numbers were smaller we divided each group into only High and Low Subgroups. The *H* subgroup consisted of all *S*'s having a plus score ($I\text{-}C > 1$); the *L* subgroup contained all *S*'s having a minus score ($I\text{-}C < 1$). We ignored the few cases having a zero score. As shown in Table 6 the school groups (Bronxville and Friends' Sem.) performed as did the Fieldston groups in that the *H* subgroup recalled *I* tasks initially while the *L* subgroup recalled *C* tasks initially These differences again are statistically reliable ($X^2 = 11.56$ $P < .01$) Contrarily, the girls' schools (Brearley and Chapin) and the colleges performed differently in that the High subgroup did not show tension for unfinished work by recalling *I* tasks initially Among the Low subgroups, however, the recall of *C* tasks initially was a dominant trend The difference in performance of the *H* and *L* subgroups is still statistically reliable ($X^2 = 6.64$ $P < .01$). In these results we have further evidence that concern over success and failure as revealed through a greater recall of initial *C* tasks, dominated the performance of the college *S*'s as well as the girls' schools (Brearley and Chapin).

b. Comments by subjects on tasks. In Motivation II the *S*'s had been asked to express their attitudes toward the tests. These comments we classified roughly into 10 categories, including reference to time, toward the test situation as a whole or to particular tasks, to self-evaluation, etc. (Table 7). The comments of the school and college groups are classified separately as well as are those for the subgroups in the schools and colleges, the High subgroup meaning here that more *I* than *C* tasks were recalled, the reverse being true for the Low subgroup Again the small number in the Middle group ($I\text{-}C = 0$) were excluded. This table shows that there is very little difference between the comments made by *S*'s who recalled more *I* or *C* tasks either in the schools or colleges If we add the percentage frequencies for Items 5, 8, 9, however, that include

These expressed attitudes, however, only partially reveal underlying trends in dynamics of behavior For instance, 43 per cent in the school group as a whole and 38 per cent in the college group said the tests were fun, that they liked them This comment might have meant anything from being really fun, as in the case of Test 12 (connecting numbers by lines) where the overt behavior of the school groups was obviously one signifying real enjoyment, to being only superficially amused and detached from an actual "fun" participation in carrying out the tasks Some of the college students qualified their statement of *fun* by adding the comments *amusing, interesting,* or *not boring.* Many underlying differences in attitude were no doubt present also in the references to time An expressed attitude of hurry or being rushed might have meant a feeling of "incompleteness" in not finishing a task, or shame for not having done a piece of work satisfactorily, or again annoyance at the experimenter for not allowing more time. In other words, we do not feel that the comments can be always placed in categories on the basis of expressed impressions

c Numbering recalled items. We looked for some possible indirect expression of underlying trends of behavior during the test situation that might stand in a greater functional relationship to the recall of interrupted or completed tasks than are written comments We noticed that a certain number of *S*'s numbered the recalled items As no reference to numbering items had been made in the instructions, we wondered if there would be any differences in test scores between *S*'s who numbered and those who did not number the listed items We first found the frequencies of numbering recalled items in the different schools and colleges (Table 8) In

TABLE 8

SHOWING FREQUENCIES FOR NUMBERING RECALLED ITEMS FOR DIFFERENT GROUPS

Motivation	Group	No. of *S*'s	No numbering items	% numbering times
I	Fieldston 10, 11	156	51	33
I	Brearley 10, 12 Chapin 12	47	11	23
II	Bronxville 10	49	28	57
II	Friends' Sem 10	21	6	29
II	Sarah Lawrence Pratt, Freshmen	66	12	18

general the younger *S*'s numbered more frequently than did the older ones There also seems to be some relationship between the frequency of numbering items and the scores for *I* and *C* tasks. The colleges and the Brearley School, who recalled the greater number of *C* tasks, numbered the recalled items the least frequently, while the other school groups, Fieldston, Bronxville and Friends' Sem., who recalled the larger number of *I* tasks, numbered the recalled items the most frequently Furthermore, the Bronxville group that numbered the items the most frequently (nearly 60%) had the smallest number of *S*'s falling in the very low difference score group (*I*-*C*), where the score was —16 or more Only 12 per cent of the *S*'s at Bronxville had difference scores as low as —16, while at Sarah Lawrence and Pratt, 42 and 50 per cent respectively had these low scores

Next we compared the performance of subgroups, those recalling more *I* tasks (High) and those recalling more *C* tasks (Low) Table 9 shows the percentage frequencies for numbering recalled items for these subgroups For all schools and colleges, more *S*'s having plus difference scores number the recalled items more often than do those having minus difference scores For Bronxville and Friends' Sem the frequency of *S*'s in the plus group numbering the items is particularly large (63%) This relationship between numbering recalled items and difference scores (*I*-*C*) is reliable statistically only in the school groups where there were greater fre-

TABLE 9

Showing Frequencies for Numbering Recalled Items for High (*I*-*C*) and Low (*I*-*C*) Subgroups

Group	Subgroup	No *S*'s	No numbering items	% numbering items
Fieldston 10, 11	High	74	32	43
Fieldston 10, 11	Low	69	19	28
Brearley 10, 12 Chapin 12	High	17	6	35
Chapin 12	Low	27	5	19
Bronxville 10 Friends' Sem 10	High	32	20	63
Friends' Sem 10	Low	26	10	38
Sarah Law. Pratt, Fresh.	High	24	5	21
Pratt Freshmen	Low	38	5	13

quencies of recall of *I* tasks. For the Fieldston, Bronxville and Friends' Sem. *S*'s, in the association between numbering and score, $X^2 = 7.15$ $P < .01$. In the college groups and girls' schools (Brearley-Chapin) where the recall of *I* tasks was much less frequent, this relationship is not reliable statistically ($X^2 = 2.09$ $.20 > P > .10$).

It would seem that numbering recalled items is not just a check on memory, to see how many items can be recalled, but is also due to the fact that the school *S*'s were interested or concerned about the individual tasks. By numbering a task it was emphasized and made a more important entity, instead of being considered only as a less important part of a battery of tests. As we have previously mentioned, Zeigarnik found that *S*'s who emphasized the recall of individual tasks independent of their relationship to the test as a whole make higher quotient scores

$$\left(\frac{I}{C} > 1\right)$$

Thus we feel that numbering the items recalled, when no mention was made by the experimenter for so doing, is a more spontaneous and unconscious expression of behavior than are verbalized impressions.

d. Correlations with other measurements. It is not within the scope of the present paper to deal in detail with the important problem of the relationship between the recall of *I* and *C* tasks and the measurement of other aspects of behavior. We do, however, want to discuss a few points here on this problem. In the first place, we found no significant relationship between recall scores and intelligence level as measured by the American Council test. The correlations were all between +.25 and −.06. Pachauri reported that he found some small positive correlations between *I* and *C* scores and tests that measured intelligence (8, p. 111). These correlations, however, were low and not reliable. His main positive contribution was that the different factors measured, fluency, persistence, intelligence, and memory all correlated positively with *I* and *C* effects (recall of unfinished and completed tasks), but that general inertia or perseveration correlated negatively with the *C* effect, positively with the *I* effect. Pachauri further partialed out a possible memory factor and found the correlations were not altered. He then concluded that the *I* effect was positively related to general inertia (a tension due to perseveration of unfinished tasks), while the opposite was true for the *C* effect. As these correlations were all quite low, we cannot consider them reliable, although they are suggestive of possible relationships between different aspects of behavior.

If in measuring the recall of *I* and *C* tasks we are actually measuring different expressions of behavior or tension systems within the organism, as seems indicated by the work of other investigators as well as ourselves, then the correlation between the recall of *I* and *C* tasks with each other should be low If memory only was being measured in recalling both types of tasks, then these correlations should be positive We find the former to be the case In the correlation of *I* and *C* scores for the schools (Fieldston, Bronxville, Friends' Sem), Pearson $r = -19 \pm .05$, for the colleges (Sarah Lawrence, Pratt) Pearson $r = -.11 \pm .09$.

If the recall of *I* and *C* tasks is due to dynamic factors within the organism, then correlations with other measures of these factors, such as perseveration as suggested by Pachauri, are indicated In another study already reported, we correlated recall of *I* and *C* tasks for the Fieldston *S*'s (Grade 10) with their Schneider index, a measure of neurocirculatory efficiency (1). We found that the *S*'s who recalled predominantly interrupted tasks had high Schneider indices (good neurocirculatory efficiency), while those who recalled predominantly completed tasks had low indices (poor neuro-circulatory efficiency) The *S*'s who recalled a more equal number of *I* and *C* tasks had medium indices These relationships were reliable statistically. Obviously, a good deal more work needs to be done in order to understand the development of tension systems within the organism and their subsequent release by memorial recall, as well as the significance of the relationship of these tensions to neurocirculatory balance Only more research and study can clarify these problems

D GENERAL DISCUSSION

Our present study was only a preliminary one. It did not presume to standardize a test for reliability and validity It was only an attempt to carry over into a test situation a methodology worked out in the laboratory. The whole approach to the study of the dynamics of behavior, even in the laboratory, is still in an embryonic stage. Certainly here is a fertile and profitable field for further exploratory work, in order to develop techniques for supplementing the measurement of intelligence and scholastic aptitude and the making of psychoneurotic inventories, and for more quickly and precisely arriving at an understanding of an individual than is possible in a case history or psychiatric interview, both of which are time-consuming and expensive

If adequately developed, measuring some of the dynamic aspects of behavior in test situations should be of help to the teacher and counselor in preventing the pitfalls of trial and error handling of pupils If a teacher understands that a pupil who develops tensions for unfinished tasks is not stupid but finds it more difficult than some of his peers to leave something undone, that he is really having a hard time adjusting to the task of multiplying mixed fractions after leaving a long division problem unsolved, she may have more patience with him The teacher may even think up ways and means of helping this pupil become more flexible, rather than spend her time despairing over his seeming stupidity. The pupil may make a high score on the American Council test, reaching the 90th percentile, while on a test for measuring the recall of interrupted and completed tasks, he may make a score of 80 per cent recall of interrupted tasks, and 40 per cent recall of completed tasks, giving him a ratio of 2 to 1 in favor of recall of unfinished work This pupil thus would have fallen in our High subgroup for the recall of interrupted tasks. Now, if his Schneider index is also high, a good deal is known about his personality make-up, even before having had many contacts with him At least more is known about him than would be the case if only the information concerning his intelligence rating were available

But also it must be realized that tension for incompleted work is not only a liability, when it interferes with adequate adjustment, but may be and frequently is, one of the most valuable assets an individual can have Without interest in a task and an accompanying desire to complete the task as well as possible, no individual could get along educationally and vocationally or in his adjustments to everyday life The problem is to find an adequate balance between completing tasks successfully or, when the occasion demands, breaking off the task without undue stress and strain in order to turn to another more urgent one.

Obviously, tensions for unfinished work are not the only dynamic aspects of behavior capable of being measured, or of importance in understanding the individual We need to know, for instance, about

8. Negligible correlations were found between scores on intelligence tests and the recall of *I* and *C* tasks

9 A positive relationship was found between a measure of neuro circulatory efficiency (Schneider index) and the recall of *I* and *C* tasks. *S*'s having high Schneider indices recalled more *I* tasks, those having low indices recalled more *C* tasks, while those with medium indices recalled a more equal number of *I* and *C* tasks

10 The importance of developing tests of this kind for measuring conative aspects of behavior, to supplement the existing intelligence and scholastic aptitude tests, is discussed.

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The Journal of Genetic Psychology, 1941, 58, 27-44

A STUDY OF THE REACTIONS OF SPASTIC CHILDREN TO CERTAIN TEST SITUATIONS*[1]

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A. INTRODUCTION

Investigators such as Goldstein (8), Bolles (2), and Nadel (16), have concluded that cerebral injury often results in a diminution of abstract behavior and a corresponding increase in more concrete responses to problem situations, as well as in a loss in ability to shift, voluntarily, from one aspect or attribute of a problem to another. This theoretical loss of function is postulated as beginning upon the "higher levels" of mentation, which are supposed to develop or mature with the maturing individual. This raises the question: Would one find a *lack* of the development of such abstract behavior in cases of brain injury during infancy or immaturity?

The condition generally known as spastic paralysis offers a possibility of investigation along these lines. Doll, Phelps and Melcher (6), Lord (13), and Scheidemann (19) have published detailed descriptions and somewhat lengthy discussions of the etiology of this type of disability. For our purposes, the description of Masten (14) may prove adequate:

> Spastic paralysis is not a disease, but a symptom, common to many disturbances of the central nervous system. Spasticity of the spinal cord . . . does not affect mental or emotional status. Disease in the brain involving motor pathways may give rise to spasticity associated with such complications as mental deficiency, epilepsy, and personality changes. Frequently tremors, jerking movements of bizarre and grotesque nature, and facial grimaces are also part of the disease. Various conditions characterized by spastic paralysis may be classified as follows: (*a*) hemiplegia, or a paralysis on one side of the body, (*b*) diplegia, which is really a double hemi-

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*Received in the Editorial Office on October 3, 1939.

[1] Rewritten portion of a dissertation presented for the degree of Doctor of Philosophy in the Department of Psychology, University of Chicago, 1939.

> plegia, and (*c*) paraplegia, which is a paralysis or weakness of both legs
>
> Any one of these conditions may be complicated by mental deficiency, by epilepsy, or by peculiar movements (choreaathetosis), depending on the location and extent of the insult

Phelps (17) distinguished between spasticity and athetosis, although other investigators, particularly Brain (4) claim that it is rarely possible to find either condition uncomplicated by the other.

Because of differences in etiology, locus, and severity of the lesion, marked differences among spastic individuals may be expected Disabilities range from cases of almost complete physical helplessness to slight involvement of one hand or foot, with all possible mental and emotional complications. Lord (12) has emphasized the difficulties involved in testing such individuals Estimates of intelligence are open to question, partly because of the inhibiting influence spasticity has upon verbal and motor expression, and partly because of possible gaps in mentation which the conventional tests do not reveal

Bolles (2), Nadel (16), and Conkey (5) have made qualitative studies of cases of brain injury based upon comparisons with normal control groups In each case brain injury patients were characterized by "stereotypy" and by impairment in the ability to perceive abstract relationships. Recent investigations by Krechevsky (11) point toward a similar tendency toward "stereotyped" behavior in rats with cortical injuries, although under the proper conditions the operated animals were able to change from a preference for "stereotyped" back to variable behavior Other studies utilizing the color-, form-, object-grouping techniques of Bolles and Nadel are those of Usnadze (23) and Tobie (22), who used children as subjects, and Weigl (24) who used normal and feebleminded children as controls for his experimental cortical-lesion group.

The most comprehensive studies of spastic paralysis have been made by Lord (12, 13) and by Doll, Phelps, and Melcher (6) Lord arranged developmental sequences of responses of both motor and ideational growth, and studied with their aid several children under six years of age, testing each three times at six-month intervals The examination procedure and the selection of test material depended upon the degree of motor disability and the emotional condition of the subject. Doll, Phelps, and Melcher collaborated on a study of 12 subjects, institutionalized at Vineland. The group ranged in age from three to 38 years.

A combination of mental tests of both the verbal and performance types was used. For the three children who were unable to respond to the usual tests, the authors offer a "tentative framework for psychological observation" based upon their studies of the language usage, attention, perception, discrimination, association, memory, number sense, performance, and ability to learn of these three children.

B. PROBLEM

The problem of this investigation was to make a qualitative analysis of the behavior of a group of spastic children in several test situations so devised that the effect of the physical disabilities of the children might be minimized while at the same time making possible some indication of the subject's ability to apprehend and to remember relationships differing in complexity. The method necessitated an intensive study of a few cases rather than a more extended study of a larger number. An equivalent group of physically normal children was selected as a control group so that it might be possible to make some comparisons of behavior.

C. SUBJECTS

Subjects for investigation included 27 children enrolled in the Spalding School for Crippled Children in Chicago, five patients in the Crippled Children's Division of the Illinois Research Hospital, and 26 physically normal children enrolled in the Jefferson public school in Chicago. Five of the children from each school were kindergarten children, used in one test of the series only. Twenty-one of the group from Spalding completed the test battery. These children, matched for sex, chronological age, and estimated mental age with children from Jefferson, furnished the bulk of the data of this investigation. Thirteen of the 21 composed the entire Special Spastic Division at Spalding. The others were attending regular classes, in spite of severe handicaps. Nineteen were spastic as a result of birth injury or injury within the first year of life. Two were injured between the ages of three and seven. Seven were diagnosed as hemiplegic, 13 as diplegic, and one as paraplegic. Seven were, in addition, athetoid. Speech, or locomotion, or manipulation was impaired to some degree in all cases, severely, in all three areas, in most cases The children had all been attending school for at least three years. The chronological age range for the Spalding group was from seven years and two months to 13 years and one month, with a mean of nine years and seven months Estimated mental ages (Stanford-Binet scale) ranged from six years and nine months to 12 years and nine months, with a mean of nine years and three months. The mental age range and mean for Jefferson subjects was exactly that for the Spalding group, the chronological age range being from seven years and three months to 13 years and four months, with a mean of nine years and nine months

D TESTS AND RESULTS

A two-fold basis determined the selection of the tests: first, an attempt to utilize test situations which might indicate the subject's ability to apprehend relationships while at the same time discounting the spastics' physical disabilities, and, second, by means of these situations to test the hypothesis that spastic children exhibit some of the gaps in mentation which have been discussed as losses in cases of brain injury after maturity. In general, there were seven main considerations, as follows. (1) The tasks must require few, if any, verbal responses, (2) the tasks must not require fine muscular coordination, (3) the amount of time taken for solution must make little difference in the results, (4) while the tasks must be difficult enough to challenge the subject, undue increase in motor and emotional tension must be avoided, (5) some indication of the subject's ability to apprehend a variety of relationships must be possible. This would include, for example: (*a*) the ability to attach meaning to pictures; (*b*) the ability to perceive form and color relationships; (*c*) demonstration of an adequate sense of spatial relationships, (*d*) the ability to understand and to follow verbal directions. (6) The tasks must permit a flexible testing period, dependent both in time consumed and in number of tasks completed per period upon individual requirements, (7) the situations should lie within the possible experiential limits of spastic school children

Four general test situations seemed to meet these conditions. The sorting technique, widely used in cases of brain injury, schizophrenia, aphasia, and the like (2, 3, 5, 8, 16, 24) was adapted for use as one of these four. A string pattern test, adapted from Settlage and Harlow (21) and designed to test acuity in spatial relationships; a "completion" test which necessitated some generalization and abstraction, and a pattern-memory test completed the battery

Testing was individually conducted by the writer Full protocols were taken of the performances of each child in each test situation. The testing program extended from March 1st to June 13th, 1939.

1 *The Sorting Test Situations*

A group of 32 objects, 54 leather, glass and cardboard forms, and two lists of words, in varying combinations, made up 13 sorting test situations. The objects included toys, foodstuffs, and articles in common use The forms were circles, squares and triangles in three-, two-, and one-and-a-half-inch dimensions Cardboard forms were in four colors yellow, blue-green, violet, and white The same objects were used over and over in different contexts in an attempt to discover whether the subject could readily shift his associations to fit the new context or whether his responses would disclose a more stereotyped sort of behavior In cases where two or three types of responses were, with the material presented, equally possible, the subject was asked to associate the articles in as many ways as he could Procedure in each of the situations was essentially the same The objects were placed on the table in front of the subject, unused objects being pushed out of the way although still within sight. The subject was then instructed to put everything together which belonged together and urged to use his own judgment in deciding the basis of "belongingness"

In three cases the aid of the examiner was required in placement In each case the subject gave explicit directions, and reasons for *desiring that particular arrangement All other spastic subjects were* able to handle the materials in some fashion without aid

The materials used in each sorting test situation are listed below, in order

1 Sorting test Situation I 16 cardboard forms, four of each color, using a sample of each form and of each size It is apparent that grouping could be on the basis of size, form, or color

2 Sorting test Situation II all yellow cardboard shapes, an *orange, a box of crayolas, wooden cube (orange colored), artificial* banana, 6 inch wooden ruler, spool of red thread, package of needles, small red rubber ball, spray of artificial red tulips, red-handled pocket knife, red pencil, red-and-white marble, small red wooden triangle,

square, and circle Here again color classifications are possible, as well as groupings of objects according to familiar use associations—for example, needles and thread

3 Sorting test Situation III all the leather, glass and cardboard circles; the red circular block, a copper kettle lid, the ball, orange, and marble; thread, and a package of lemon "Lifesavers." Classifications might be upon the basis of size, color, material, or shape

4 Sorting test Situation IV: all the leather, glass, and cardboard squares, square red block, a picture of a typewriter mounted on a square piece of cardboard, a square pad of paper, two glass, two rubber, and one candy cube Materials presented were either squares or cubes, but some of them were also objects which might or might not be recognized as falling into "shape" categories

5. Sorting test Situation V. all leather forms, all glass forms, and 12 of the cardboard forms, using each color, with four of each shape and four of each size Classifications on the basis of size, shape, color, or material were the most obvious possibilities here

6. Sorting test Situation VI. all leather and glass forms, the three wooden blocks, two wooden cubes, ruler, pencil were used here. It was hoped that groupings on the basis of material might be made more obvious here than in the situation immediately preceding this one

7 Sorting test Situation VII glass cubes, one circle, one triangle and one square of glass in different sizes, one sample of each color of the cardboard forms, using all three shapes; needles, a bunch of gilt safety pins, knife, a small toy locomotive, and an ordinary door key Again the objects might be sorted according to material, shape, or size.

8 Sorting test Situation VIII. this situation and the three immediately following made more use of objects than of forms. Materials for Situation VIII were the key, knife, thread, Lifesavers, an artificial potato, locomotive, blocks, all cubes, small doll, toy cat, toy dog, marble, ball

9. Sorting test Situation IX pencil, paper, crayolas, ruler, picture of typewriter, banana, cat, glass cubes, bottle of paste, bar of Ivory soap.

10 Sorting test Situation X: needles, pins, soap, key, pencil, thread, potato, tulips, kettle lid, marble, small package of chewing gum.

11 Sorting test Situation XI: ball, key, knife, locomotive, paste, banana, orange, chewing gum, candy cube, Lifesavers, potato, small box of crackers.

12. Situation VIII emphasized toys, IX included articles in common use at school, X included objects in common use at home, while XI included a preponderance of edibles.

The next two sorting test situations were verbal, and were presented to 11 only of each group. Two lists of 14 words each were used. Each word was presented separately, and the subjects instructed to put all the words together that belonged together. The first list was made up of the names of animals, birds, and one flower. The second included the names of foods and familiar objects, so selected that classifications on the basis of color might also be made.

In these situations several group differences were noticeable. Within a given test situation the crippled children exhibited wider varieties of response. An instance of this sort of behavior from sorting test Situation III, for example, is as follows:

Placement by shape, or shape and size	spastics, 8,	normals, 11
Placement by shape, material and color	spastics, 2,	normals, 9
Placement by color only	spastics, 3,	normals, 0
Placement by material only	spastics, 2,	normals, 0
Placement by size only	spastics, 1,	normals, 0
Placement by fantasy or design	spastics, 4,	normals, 0
Placement by objects vs forms	spastics, 1,	normals, 0

Here 11 spastic subjects made responses which none of the normal subjects made at all. Another example, taken from Situation VI, is as follows.

Placement by material and shape	spastics, 7,	normals, 10.
Placement by shape only	spastics, 3,	normals, 0
Placement by shape and size	spastics, 5,	normals, 11
Placement by fantasy or design	spastics, 3,	normals, 0
Placement by color	spastics, 1,	normals, 0.
Placement by familiar use associations	spastics, 3,	normals, 0

Perhaps the most striking example of this sort of response on the part of the spastic subjects may be found in sorting test Situation X, where objects used were predominantly edible or non-edible. All the normal children so classified the objects, while only nine of the spastics did so, nine others grouping them according to color, shape, or size, and three more classifying according to fantasy or familiar use, one spastic subject being unable to see any relationships whatever. Not only were these response patterns widely dispersed within any one situation, they tended, moreover, to be stable An individual who classified objects in one situation according to color, for example, frequently so classified materials throughout the test series, often overlooking relationships which were apparently more obvious or natural This behavior we have called "stereotyped"

While the normal children often retained the same general classification tendency from situation to situation, most of them were able to vary their responses when called upon to do so. Spastic children exhibited this ability in only a few cases The spastic group further made considerably fewer comprehensive responses throughout the series than did the normal children

TABLE 1

SUMMARY OF RESULTS IN SORTING TEST SITUATIONS I-XIII

	Type of response	Spastics	Normals
1	Total classifications on the basis of color	40	19
2.	Total classifications on the basis of shape	70	98
3	Total classifications on the basis of size	27	36
4.	Total classifications on the basis of material	21	13
5	Total classifications on the basis of familiar associations	42	43
6	Total classifications on the basis of comprehensive relationships*	65	99
7	Total classifications on the basis of fantasy and design	30	1

*These totals include some of the color, shape and material classifications totaled above.

Table 1 presents a summarized account of the sorting test situations in general An apparent preference for color classifications was exhibited by the spastics over the normals, whereas normal subjects were more inclined to group materials according to shape than were the spastics Classifications on the basis of comprehensive relationships and "fantasy" responses also show rather significant differences No differences were found in frequency of familiar-use associations, in contradistinction to the difference in comprehending less obvious relationships

For both groups the impulse to form color, size, or shape categories seemed to be basic, and when the subjects could not comprehend other relationships, they fell back upon this "basic" principle. As noted, this tendency was more marked among the spastic group

2 *The Light Pattern Test*

The second type of test situation was primarily a memory test in which the subject repeated a patterned sequence of colored lights A red, a white and a blue light were mounted so that they could be turned on and off in any order by either subject or experimenter Because of the independent action of the lights, the patterns could be varied at will and indefinitely increased in complexity Sequences began with two-light patterns, and continued until the subject failed five out of eight patterns of a given complexity. The subjects' responses were not timed, although in the patterns set for reproduction a light was turned on every three seconds, remaining lighted for one second A summary of the results is presented in Table 2

TABLE 2
SUMMARY OF THE RESULTS OF THE LIGHT-PATTERN TEST

Type of response	Spastics	Normals
1. Successfully completed five-light patterns (upper limit)	0	2
2 Successfully completed four-light patterns	11	10
3 Successfully completed three-light patterns	8	9
4 Successfully completed two-light patterns	1	0
5 Exhibited "stereotyped" behavior	9	1

The failures brought out differences among the spastic and normal children which the successes, of which there was approximately an even number, at the same levels, in each group failed to do While the normal children and a few of the spastics tended to guess if they were *not sure of the proper response, most of the spastic children* tended to exhibit "stereotyped" behavior—that is, to repeat the same pattern over and over, or to repeat the pattern immediately preceding the one forgotten

Mental age apparently has some rather definite connection with the ability to reproduce the more complex patterns The children with mental ages between six and eight years were in general limited to three-light patterns, while the mental age range from 10 to 12 included most of the individuals successful with four- and five-light patterns The principle of this test is, of course, the same as that of such tasks as repeating digits, words or sentences in the Stanford-Binet scale

3 *The "Completion" Test*

Three heterogeneous groups of objects, three of pictures, and four of words were presented in this test. The one thing which each object within a group had in common with all others was something which was *lacking* to complete it or to render it useful. Three objects, pictures, or groups of letters were provided from which the subject was to choose, for the group, the one common element. His responses indicated whether he had grasped the idea that all of the objects of the "incomplete" group needed the *same* one object to complete them, whether he was able to recognize this object when he saw it; and whether he was able to proceed from quite concrete to somewhat abstract "completions" in this manner. All of the objects and pictures were familiar to the children. Words were taken from the Buckingham *Word List*.

Results of the test are summarized in Table 3. When the first and second trials were combined, little difference between the experimental and the control groups in their responses to concrete and pictorial material was found. Twice as many normal children as spastics, however, successfully completed at least three of the four verbal tasks. Three spastic children exhibited "stereotyped" behavior, consistently choosing on the basis of the spatial relationship of the "completion" articles to themselves, rather than from any comprehension of the problem itself.

TABLE 3

SUMMARY OF RESULTS IN "COMPLETION" TEST

Types of response	Spastics	Normals
1 All concrete tasks correct on first or second trial	13	15
2 All pictorial tasks correct on first or second trial	14	14
3 Three to four verbal tasks correct on first or second trial	4	8
4 One to two verbal tasks correct on first or second trial	11	4
5 Exhibited stereotyped behavior	3	0
6 Consistently guessed when in doubt	4	7
7 Matched items instead of completing the series	1	3
8. "Gave up" when in doubt	4	5
9 Consistently needed second trial	3	1

Aside from the time consumed in actually attempting to manipulate the articles, the spastic children as a group were markedly more deliberate than the normals Some spastic subjects studied the series for from one to three minutes before starting to respond. In addition to the stereotypy already mentioned, three general types of behavior apparently followed when the subjects were upon uncertain ground guessing (more normal than spastic subjects), matching items (both groups), and giving up (both groups)

4 *The Patterned String Test*

Variations of this sort of test situation have been applied to many types of subjects including cats, monkeys, chimpanzees, and young children (1, 9, 15, 18, 21) In this test 20 patterns were used, four each utilizing two, three, four, five, and six strings. The first nine in the series were taken from Settlage and Harlow (21), and were those which they had found most difficult for their sub-human primate subjects Figure 1 shows examples of more difficult patterns

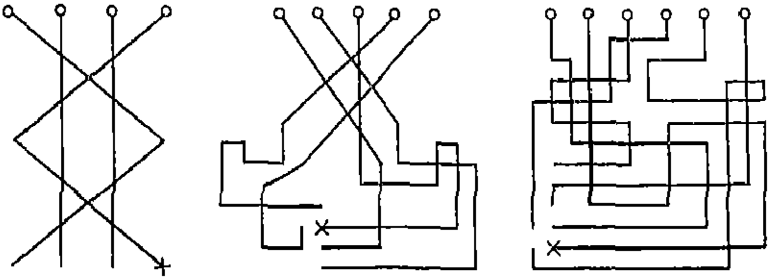

FIGURE 1

EXAMPLES OF FOUR-, FIVE-, AND SIX-STRING PATTERNS

Circles represent bracelet pulls; x represents the lure

used in this study The "lure" in each case was a package of Lifesavers for which the subject had previously expressed a preference. Free ends of the strings next to the subjects were secured to bone bracelets to facilitate handling Kindergarten children were used in this test only A summary of the results is presented in Table 4

In general, there was little difference between the two groups so far as actual success or failure in solving the patterns was concerned Two general methods of solution were noticed The

TABLE 4
SUMMARY OF RESULTS IN STRING-PATTERN TEST

	Types of response	Spastics	Normals
	A *Number of patterns correctly solved on first trial*		
1	Nineteen to twenty	11	11
2	Fifteen to seventeen	3	4
3.	Twelve to fourteen	1	2
4	Nine to eleven	1	1
5	Six to eight	3	2
6	Three to five	1	1
	B *Overt movement utilized in obtaining solution*		
1	Extensive head, trunk and arm movements	11	0
2	Extensive finger movements	1	3

first, and most successful, was fixation of the lure with the eyes and tracing the path of the string leading from the lure to the bracelet with swift eye-movements The second and less successful method was to begin with the bracelets and trace the path of each string in turn until one terminated at the lure. Tracing was done visually with no body movements, or with the aid of a pointing finger, or with movements of head and trunk Eleven spastic subjects seemed to depend upon extensive movements in tracing the patterns of the strings There were more complete failures among the younger children of both groups.

E DISCUSSION OF RESULTS

Several questions are suggested by the results of the tests First, are group differences merely a result of the lack of expressional ability and narrowed experience of the spastic subjects, or is there some basic difference aside from these? Again, are there any demonstrable relationships between, for example, verbal or manipulatory difficulties and specific types of response such as stereotypy or fantasy? Is the relatively frequent use of shape as a category among spastics related to difficulties in manipulation? Are unusual responses of spastics analogous to the type and severity of their disability? Are there demonstrable differences in the responses of spastic children to spatial relationship? Is inability to shift from one basis of classification to another more characteristic of spastic than of normal children?

In Table 5 the responses of the hospitalized subjects are summarized with those of the Spalding group Total responses are

TABLE 5

SUMMARY OF RESPONSES OF SPASTIC SUBJECTS TO ALL TESTS

			Type of Response			
Spastic case *number*	Total color *resps*	Total shape *resps*	Stereotyped *responses*	Fantasy *responses*	Random *responses*	Flexibility *in shifting*
1	1	3	Frequent	4	2	Present
2.	0	0	Frequent	11	2	Absent
3	1	3	Rare	2	1	Present
4	2	0	Rare	0	2	Present
5	5	0	Frequent	0	5	Present
6	0	5	Frequent	0	0	Absent
7	3	1	Rare	1	2	Present
8	1	3	Frequent	1	0	Absent
9	0	9	Frequent	0	1	Absent
10	1	6	Frequent	0	0	Absent
11	3	3	Frequent	0	0	Absent
12	0	9	Frequent	0	0	Absent
13	1	3	Rare	0	0	Present
14	1	9	Frequent	0	1	Absent
15	5	1	Frequent	1	3	Absent
16	0	4	Frequent	1	0	Absent
17	1	1	Frequent	9	3	Absent
18	2	1	Rare	0	3	Present
19	2	0	Rare	1	1	Present
20	3	5	Frequent	0	1	Absent
21	1	5	Frequent	0	0	Absent
Max*	3	0	Rare	0	4	Present
Betty*	2	2	Rare	1	0	Present
Joe*	0	0	Frequent	4	2	Absent
Glenn*	2	0	Frequent	0	0	Absent
Roman*	4	0	Rare	3	8	Present

*Hospital case

not the same in all cases because not all of the children completed all of the separate test situations Among the Spalding group, Cases 4, 5, 10, 11, 12, 14, 15, 16, 17, 19, and 20 were most severely handicapped in the three behavior areas noted If narrowed experience is the dominant factor in differentiating between the spastic and normal groups, these 11 cases might be supposed to exhibit less comprehensive behavior, to prefer color to shape categories, and to have special difficulty with verbal material

Four of these subjects were included in the 11 who responded to sorting test Situations XI and XIII. Three out of nine made acceptable responses in Situation X, while two of the three acceptable responses in Situation XIII were made by them Three of the group of 11 were not successful with any of the verbal materials in the "completion" test, and six of them were successful in only one or two of the series. Two of them, however, were successful in all but one of the verbal tasks.

Sixteen spastic subjects exhibited stereotyped behavior, 10 of them with a great deal of consistency. These were Cases 2, 9, 10, 12, 17, 20, 21, and 22, plus two of the hospitalized patients. Three of the 10 were spastic diplegics, three were athetoid, three were hemiplegic, and one was paraplegic. No special relationship between type of disability and stereotyped behavior was thus apparent. Eight of the 10, however, were severely handicapped in speech. Three of the 10 are among the 11 most severely handicapped of the Spalding group. Only two of the most severely handicapped children (Cases 4 and 19) did not exhibit stereotyped behavior.

Stereotypy apparently has little relationship to the estimated mental ages of our subjects. None of the children who did not respond in this way had an estimated mental age under 8-7, and their *IQ*'s ranged from 94 to 122. Six other children with the same *IQ* range did, however, respond in a stereotyped fashion. These six were all severely handicapped. Time of injury apparently made little difference in stereotyped behavior. Five of the six spastic children who did not respond in this fashion had *no* speech difficulties, while two of them had relatively slight disturbances of manipulation and locomotion.

"Fantasy" responses were characteristic of three subjects especially, although six others occasionally exhibited responses of this type. Two of the three most often making this type of response had severe disturbances of speech, although in other respects they were not especially similar. The third subject making this type of response with some regularity was severely disturbed in speech and locomotion, slightly in manipulation.

These findings would indicate that a severe speech difficulty was more often connected with stereotyped behavior, with "fantasy" responses, and with difficulty with verbal (abstract) material than such categories as estimated mental age or type and severity of disability in general. It may be that injury which affects the speech areas of the cortex may in turn affect the development of the association areas, whereas injuries affecting motor abilities necessary for locomotion and manipulation do not necessarily have this effect

There is little evidence in the study that differences are based upon experiential deficiencies Table 5 shows that while some of the 11 most severely handicapped children consistently preferred color to shape classifications, others as consistently preferred shape to color Although the spastic group as a whole generalized on the basis of shape less often than did the normal children, this was apparently not due wholly to lack of manipulation experiences Four of the most severely handicapped children in this respect preferred shape distinctions to color, and a fifth showed no preferences between the two categories.

Sorting test Situations VIII and XI present differences which might be due to the wider possibilities of experience for normal children. Upon closer examination this hypothesis seems doubtful All the subjects have experienced food to about the same degree, yet, *as shown, the spastic children made comparatively few classifications* on this basis, whereas all the normal children did so It is rather an expression of stereotypy—the inability to see relationships other than shape or color—which leads to these differences

With respect to spatial relationships, the methods used in obtaining the end were more important than the end itself Spastic children between seven and 13 years of age have inevitably learned to make adjustments to spatial relationships, in spite of physical handicaps Muscle training is, in part, of this type These adjustments may be clumsy and inaccurate, but the child will develop the method of attack which for him most often ends in success The subjects in this case exhibited this ability in a rather marked manner With the aid of gross trunk, head, and arm movements, the older children grasped the string-pattern problem easily, and solved it with little trouble The one exception is an individual who has been diagnosed as a case of arrested development, and whose behavior throughout the test situations was exceedingly infantile

No differences in comprehending the type of pictorial material presented in this study were found Correct responses to both the completion and the light-pattern tests did not differ substantially from those of normal children, although analyses of failures did bring out the greater tendency of spastic children to behave in a stereotyped fashion

It was hoped that a series of test situations might be devised which would give rather definite indications of the mental processes of spastic children, while at the same time minimizing the effects of the motor involvement This hope has apparently been realized to some extent Amplification and refinement of some of the test situations of the study might well result in a mental test especially designed for spastic children Such a test is badly needed The "completion" and light-pattern tests could probably be so refined and amplified, and certain of the sorting test situations, especially those dealing with color, form, and material, might also be standardized. Further experimentation along these lines is advisable

F. SUMMARY AND CONCLUSIONS

In this study 26 spastic school children, matched with 26 physically normal school children by sex, chronological age, and estimated mental age, were given a series of tests in an attempt to discover, first, whether demonstrable behavior differences aside from the obvious physical disabilities existed between the two groups, and, second, to discover the significance of such differences if they existed Five additional spastic subjects without school experience were also given some of the tests

Tests used in the study included a series of 13 sorting situations; a completion test involving concrete, pictorial, and verbal material; a light-pattern memory test, and a string-pattern test

With one or two exceptions the spastic group differed demonstrably from the normal in three general respects first, a wider range of individual differences in type of response within any one test situation, with bizarre or fantastic responses found only among the spastics, second, a greater tendency toward more concrete types of response, with less ability to shift toward the more abstract forms of behavior; and, third, a greater tendency toward stereotyped responses no matter what the nature of the test situation Consistency within the battery was the rule in nearly all cases

While these differences are no doubt due in part to the effect of the injuries upon the experiences of the spastics, there may be in addition a direct effect which can be attributed to the injuries themselves . for example, injury resulting in speech defect. There seems to be evidence that these children are affected by their cortical injuries in somewhat the same fashion as are cases of brain injury after maturity. This hypothesis, however, needs neurological verification.

The test materials are suggestive as possibilities for a mental test especially designed for spastic children

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The Journal of Genetic Psychology, 1941, 58, 45-56

DIFFERENTIAL FACTORS IN SPECIFIC READING DISABILITY: I LATERALITY OF FUNCTION*[1]

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A INTRODUCTION

The aim of the present study was to compare a group of retarded readers with a group of average readers on laterality of function, that is, eye dominance, hand dominance, and hand versus eye dominance, *in order to determine whether or not it is related in a primary or in a contributory way to reading disability.*[2] Previous attempts to isolate the causes of reading disability have been numerous, and prominent among the factors which have been investigated is laterality of function (1, 3, 4, 5, 7, 12) Heterogeneous compositions of experimental groups, however, together with varying investigatory techniques and in some instances absence of control groups have contributed to considerable disparity of results

Eighteen boys average in reading achievement and a like number retarded in reading achievement by one or more years below both mental and chronological ages constituted the control and the experimental groups, respectively, and have been fully described in another article.[3] It may be restated here that they were school boys between the chronological ages of 8 years 11 months and 9 years 11 months, were average in intelligence, had been in school an equal number of years, and were from unilingual, American-born families of middle socio-economic status The achievement tests employed in the selec-

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*Approved for publication by Walter Miles, and received in the Editorial Office on October 14, 1939

[1] This paper reports part of a dissertation presented in partial fulfillment of the requirements for the Degree of Doctor of Philosophy at Yale University in 1935 The writer is indebted to Dr W R Miles and to Dr C C Miles, *under whose direction this study was done, for their suggestions and interest in the work*

[2] Other functions, viz, auditory acuity, discrimination and memory, visual functions, fluency of verbal associations, and personal adjustment, as related to reading disability will be presented in a subsequent article

[3] Wolfe, L S An experimental study of reversals in reading *Amer J Psychol*, 1939, 52, 533-561

tion of the subjects showed the two groups to be definitely of different samples in reading and spelling but of the same sample in arithmetic computation

B. Eye Dominance

1. *Procedure*

Eye dominance was determined by use of the Miles *A-B-C Vision Test* which employed three *V*-scopes and 10 picture cards (9, 10). The test for each child consisted of 15 trials, the last five of which were preceded by 10 forced views with the non-dominant eye. Presumably, in cases in whom dominance was not well established, forced use of the non-dominant eye would encourage its use in immediately subsequent trials and thereby be valuable in revealing different degrees of dominance. Retests exactly duplicating the tests were given between eight and fourteen days later. Dominance was considered established if at least 80 per cent of the total 30 trials were consistent.

2. *Results*

All subjects showed definite eye dominance (Table 1). Thirty-nine per cent of the experimental group and 44 per cent of the con-

TABLE 1

Number and Per Cent of Subjects Who Demonstrated Right or Left Eye Dominance on the Miles *A-B-C Vision Test* in the Experimental and the Control Groups, with Critical Ratios

(The number of subjects in each group was 18.)

Dominant eye	Per cent of dominance on 30 trials	Group of subjects Experimental N	Experimental Per cent	Control N	Control Per cent	D/σ_d
Right	100	8		8		
	97	3				
	93			1		
	82			1		
Total:		11	61	10	56	2.94
Left	100	3		4		
	97	1				
	93	1				
	87			3		
	83	1		1		
	80	1				
Total		7	39	8	44	2.94

trol group were left eyed. The difference between these per cents, which is 2 9 times its sigma, may have been at least partly due to the small number of subjects in the groups The incidence of left eye dominance in both groups was greater than that found by other investigators with larger populations (9, 10, 14) Only one subject responded to the forced use of his non-dominant eye by substantial decreases in the number of choices of the dominant eye This individual was the left eyed experimental subject who is designated in Table 1 as 80 per cent left eyed

Consistency of eye choices for each subject, when expressed in terms of the per cent of agreement between test and retest trials, gave a range from 67 to 100 per cent for the experimental subjects and from 73 to 100 per cent for the control, with averages of 94 and 93 for the two groups of subjects, respectively Designation of eye dominance, according to the percentage criterion adopted, was the same for each individual on the test and retest series

C HAND DOMINANCE

In order to determine hand dominance, or the functional relationship of the right and left hands, a group of motor tests, a group of unimanual choice tests, and a questionnaire were used

1 *Relative Skills*

a Tests and procedure Four motor tests were used to determine the relative skill of the right and left hands the Miles *Motility Rotor*, *Reach and Grasp*, and *Reaction Time* tests, and a dart throwing test The trials for the two hands on any one test were arranged in an *ABBA* order. Short rest periods were allowed between successive trials on the *Motility Rotor* and between groups of six trials on the other three tests

The Miles *Motility Rotor Test* for measuring coordination speed was administered in the standard way (8, 13) For the beginning trials the apparatus was placed directly in front of the subject so that opportunity to grasp the handle with either hand was available. Twelve 10-second trials were given with each hand They were arranged as follows three right, six left, six right, six left and three right if the subject began with his right hand, or three left, six right, etc , if he began with his left hand

The Miles *Reach and Grasp Test*, designed to measure speed of a coordinated reaction, and the Miles *Reaction Time Test*, for measuring simple reaction time to an auditory stimulus presented with varying foreperiods, were administered in the prescribed manner (11). For each of these tests 24 trials per hand were given in the same order as were those for the *Motility Rotor Test*.

For a dart throwing target a cellotex board 36 cm in diameter was used Upon the board were described four varicolored concentric circles with diameters of 9, 18, 27, and 36 cm This target was attached to a stand adjustable to the shoulder heights of the subjects. Each dart weighed 15 gms and was 7½ cm. in length including the 3⅞ cm paper wing tail A toe-line from which overhand throws were made was two meters from the target The number and order of trials were the same as those for the *Reach and Grasp* and *Reaction Time* tests. The scoring system, similar to the one used by Carver (2), gave one point for hitting the outside circle, two points for the next, three for the next, and four for the innermost one.

b. Results. The data from the relative skill tests will be presented for the tests both separately and combined. The scores made by each subject on a given test were first represented by the ratio of the mean score of one hand to that of the other hand. Then the mean ratios for each group were calculated and appear here in tabular form Ratios for all tests were computed to show directly the relative skill of the two hands in such a way that ratios above 1.0 indicate superiority of the right hand while those below 1.0 indicate superiority of the left hand.[4]

Table 2 shows the mean ratio scores of each group of subjects on the relative skill tests and comparisons of the two groups in critical ratio units. The differences between the two groups on hand dominance as determined by these tests were neither statistically significant nor consistent in direction[5]

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[4] Extensive statistical analysis of the subject's scores on the relative skill tests was made to determine the reliabilities of the measures, the intercorrelations of the various performances, and effects of practice These data may be secured in full from the author. By way of summary here, the following may be stated (*a*) The uncorrected reliabilities for all subjects combined were 94, *Motility Rotor*, 64, *Reach and Grasp*, .41, darts, .10, reaction time (*b*) The effect of practice on the various performances was statistically insignificant.

[5] A critical ratio of 2.89 was considered significant. It is the value of *t*

TABLE 2

MEAN RELATIVE-SKILL SCORES ON FOUR MOTOR SKILL TESTS FOR THE EXPERIMENTAL AND THE CONTROL GROUPS, WITH STANDARD ERRORS OF THE MEANS AND CRITICAL RATIOS

(The number of subjects in each group was 18.)

	Group of subjects				
	Experimental		Control		
Tests	M	σ_m	M	σ_m	D/σ_d
Reach and Grasp	1.04	.016	1.09	.031	1.43
Motility Rotor	1.24	.054	1.23	.038	.15
Darts	2.30	.311	1.84	.212	1.22
Reaction time	1.01	.024	1.00	.035	.24

The test results (excluding those of reaction time because of low reliability) were combined to obtain the best possible estimate of the relative skills of the subjects. The combination was accomplished by use of a formula given by Kelley (6, p. 69). The obtained weights were 2.7 for *Reach and Grasp*, 20.8 for *Motility Rotor*, and .2 for dart throwing. The ratio scores for the individuals on each test were weighted, summed, and then divided by 23.7, the sum of the weights, in order to put the scores back into comparable form with those of the single tests, i.e., so that scores above one indicated right hand superiority and those below one, left hand superiority. The results for the groups are presented in Table 3. The difference between the control and experimental subjects on the combined weighted motor skill tests was not statistically significant.[6]

TABLE 3

MEAN RATIO SCORES ON THE COMBINED WEIGHTED MOTOR SKILL TESTS FOR THE EXPERIMENTAL AND THE CONTROL GROUPS, WITH STANDARD ERRORS OF THE MEANS AND CRITICAL RATIO

(The number of subjects in each group was 18.)

	Combined weighted scores		
Groups of subjects	M	σ_m	D/σ_d
Experimental	1.23	.085	.11
Control	1.22	.040	

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which Fisher considers very significant for 17 degrees of freedom, or n-1 for the present study.

[6] The reliability of the combined weighted ratios was .91 (6, p. 73).

Four experimental and two control subjects made ratio scores under 1.0, left hand dominance, on the combined weighted tests.

2. *Unimanual Choices*

a. Tests and procedure. The 17 tasks used to determine unimanual choice may be divided into two groups One group consisted of seven tasks which had been directly practiced by some or all of the subjects. sawing, hammering, erasing, drawing, catching a bounced ball, throwing a ball, and writing. Writing was the one task which had likely been most universally influenced by social pressure, but it was included on the ground that left handed writing, barring accidents to the right hand, is a fairly sure indication of left hand dominance although the reverse is not true The other group of tests consisted of tasks which had received only indirect practice throwing darts, cutting with a letter opener along two folds in a piece of paper, spinning a top directly with the fingers, removing a piece of paper from the center back of the collar, pointing to the notch on the neck (the last two mentioned tests having the advantage of being performed without the guidance of direct vision), picking up a ball from between the subject's feet, picking up a dart which was on a table one meter in front of the subject, grasping the handle of the *Motility Rotor*, and pushing down the key preparatory to the *Reach and Grasp* test and to the simple reaction time responses. Unimanual choices for the last three mentioned performances were recorded for the first three trials on the motor skill tests before the subjects had been directed to perform with a given hand The test objects were placed in the subject's median plane so that equal opportunity was afforded the two hands. An impression was given the subjects that speed and accuracy of reaction were the items under observation.

The test series consisted of three trials for each task A retest series of three trials was given from two to five days after the test series To reduce perseverative choices of the same hand for a given task, successive trials on any one task were separated by trials on all other tasks. During a single experimental period only one trial per task was given.

b. Results. Scoring was done in terms of right hand choices. The number of times each subject used his right hand for the execution of the tasks in the test and retest series combined was expressed as a percentage of the total 102 choices.

The extent of the difference between the two groups in the choice scores on the battery, as given in Table 4, was negligible Thus the groups were similar on hand dominance as indicated by unimanual choices Four experimental and two control subjects showed left hand dominance, i e, scores below 50 One experimental subject exhibited just no dominance at all by scoring exactly 50.

TABLE 4

MEAN SCORES ON THE UNIMANUAL CHOICE TEST BATTERY FOR THE EXPERIMENTAL AND THE CONTROL GROUPS, WITH STANDARD ERRORS AND CRITICAL RATIO

(The number of subjects in each group was 18)

Groups of subjects	M	σ_m	D/σ_d
Experimental	75	084	84
Control	84	066	

The reliabilities (Pearson) of the battery, obtained by correlating test and retest scores, were 94 and .98 for the experimental and control groups, respectively, and .95 for the groups combined

Consistency in performing the separate tasks was determined by percentage of agreement of hand choices between the test and retest series Table 5 shows the number of subjects who gave various percentages. One hundred per cent indicates perfect agreement in three test and three retest trials, 66⅔ per cent, agreement in two of the retest trials, and so on The experimental group showed somewhat greater consistency than did the control group Both groups showed inconsistencies on the same tasks save drawing and catching a ball The tasks on which variability resulted were less practiced, more spontaneous ones[7]

3 *Rated Functions*

a Procedure As a supplement to the experimental results, a

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[7] The intercorrelations of the separate unimanual tasks with the remaining tasks of the battery ranged from 32 to 95 The correlations between the unimanual tasks and the relative skill tests were *Motility Rotor*, 75, *Reach and Grasp*, .51, darts, 49, reaction time, —37 The complete intercorrelations may be obtained from the author

TABLE 5

Number of Subjects Showing Different Per Cents of Agreement on the Unimanual Choice Tests between the Three Trials and the Three Repeat Trials for the Experimental and the Control Groups

Tests	Experimental group 100%	66-2/3%	33-1/3%	0%	Control group 100%	66-2/3%	33-1/3%	0%
1. Throwing darts	18				18			
2. Paper cutting	18				18			
3. Hammering	18				18			
4. Sawing	18				18			
5. Writing	18				18			
6. Erasing	18				18			
7. Drawing	17	1			18			
8. Spinning top	17	1			16	1	1	
9. Catching ball	17	1			18			
10. Throwing ball	18				18			
11. Motility rotor	17		1		15	2		1
12. Reach and Grasp	15	1		2	15	2		1
13. Reaction time	16	1		1	13	4		1
14. Pointing to notch on neck	15	1		2	15	1		2
15. Taking paper off back of collar	17			1	14	2		2
16. Picking up ball	15	3			14	3	1	
17. Picking up dart	14	3	1		15	3		

questionnaire concerning hand dominance and other factors related to the study (see Table 6 for the items) was sent to each subject's parent or parents.

b. Results. Before the results of the entire questionnaire are presented, the first item will be considered in its relation to the quantitative results described in the foregoing sections. Four experimental and two control subjects were reported as left handed, one experimental subject was described as about equally able with both hands and as having been encouraged to use his right hand in infancy when he tended to use his left. The parents' statements of their children's dominant hands agreed in all instances with designation of hand dominance as determined by the relative skill and unimanual choice tests.

The agreement between the parents' statements and quantitative test scores should be regarded as an indication of reliability rather than as a measure of validity (if by validation of hand dominance

TABLE 6

RESPONSES (EXPRESSED AS PER CENTS) TO QUESTIONNAIRE SENT TO PARENTS OF SUBJECTS IN THE EXPERIMENTAL AND CONTROL GROUPS

(The number of subjects in each group was 18)

Question	Response	Experimental group		Control group		
		%	σ_p	%	σ_p	D/σ_d
1. Subject considered	right handed	72	11	89	8	1 21
	left handed	22	10	11	8	85
	"equally skillful"	6	6			1 00
2 When young, subject was expected to be	right handed	67	11	83	9	1 14
	left handed	28	11	17	9	79
	didn't notice	6	6			1 00
3 Subject was encouraged to use	right hand	72	11	27	11	0
	left hand	22	10	6	6	1 33
	neither	6	6	22	10	1 33
4. Injuries to hand	none	100		100		0
5 Illnesses making subject seem "different" afterwards	none	100		100		0
6 Subject has always handled self	very well	39	12	39	12	0
	well	61	12	50	12	65
	a little awkward			11	8	1 38
7 Siblings are	right handed	66 67*	9 90	82 56	7 86	1 26
	left handed	25 00	8.57	11 89	6 22	1 26
8. Subject's mother is	right handed	83	9	94	6	1 00
	left handed	11	8	6	6	56
	unknown (deceased)	6	6			1 00
9. Subject's father is	right handed	83	9	94	6	1 00
	left handed	11	8	6	6	56
	unknown	6	6			1 00
10 Mother's family	all right handed	50	12	89	8	2 79
	most right handed	33	11	11	8	1 57
	unknown	17	9			1.89
11 Father's family	all right handed	56	12	61	19	29
	most right handed	17	9	33	11	1 14
	some right handed	6	6	6	6	0
	unknown	22	10			
12 Some speech disorders	in family	6	6			1 00
	in relatives	6	6			1 00
13 Some reading difficulty	in family	17	9			1 89
	in relatives	11	8			1 38
14 Some writing difficulty	in family					
	in relatives	6	6			1 00
15 Some spelling difficulty	in family	6	6			1 00
	in relatives	11	8			1 38

*Number of siblings reported right and left handed in each family was put into per cents and the average per cent right and left handed was then computed with $N = 18$, the number of subjects in each group is meant checking hand performance at the time of study against some criterion of hand dominance unhampered by practice and social pressure) since it is likely that the parents' statements were based upon observations of the children in similar, though more numerous, situations What the comparison probably amounts to, then, is a check of skills and choices in controlled situations against observations of choices and possibly skills in more numerous uncontrolled situations

The results of each item of the questionnaire appear in Table 6. The number of subjects in each group rated under the different categories by the parents was expressed in per cent so that the significance of the differences between the groups could be computed Four of the experimental subjects who were expected to be left handed when they were young and were encouraged to use their left hands were the ones who showed left hand dominance on the experimental tests The one experimental subject who was described as about equally skillful with both hands was expected to be left handed when young but was encouraged to use his right hand The two control subjects who showed left dominance in the tests were expected to be left handed when young and were not encouraged to use either hand

Of the 15 items of the questionnaire, the differences, though not significant statistically, were in favor of the experimental group for more left handed siblings, more left handed mothers and fathers, more left handed members of the mothers' families, and more speech, reading, writing, and spelling difficulties among the relatives. That only a few of the reading disability subjects were viewed as such is evidenced in Item 13

D RELATION OF HAND TO EYE DOMINANCE

That crossed hand and eye dominance is related to reading disability has been suggested by certain investigators. This relationship did not hold for the group in the present study, for as Table 7 indicates, the experimental and control groups were strikingly similar in the number of subjects having various combinations of eye and hand dominance as determined by the methods used.

TABLE 7

NUMBER OF SUBJECTS SHOWING DIFFERENT RELATIONSHIPS OF EYE DOMINANCE ON THE MILLS *A-B-C Vision Test* AND HAND DOMINANCE ON THE COMBINED MOTOR-SKILL TESTS (*A*) AND ON THE UNIMANUAL CHOICE BATTERY (*B*), FOR THE EXPERIMENTAL AND THE CONTROL GROUPS

(The number of subjects in each group was 18)

Hand dominance	Eye dominance	*Experimental* group	*Control* group
	(*A*)		
Right	Right	10	10
Right	Left	4	6
Left	Left	3	2
Left	Right	1	0
Crossed eye and hand dominance		5	6
Same eye and hand dominance		13	12
	(*B*)		
Right	Right	9	10
Right	Left	4	6
Left	Left	3	2
Left	Right	1	0
None	Right	1	0
Crossed eye and hand dominance		5	6
Same eye and hand dominance		12	12
No hand dominance and right eye dominance		1	0

E SUMMARY

1. Two groups of nine year old boys, one retarded and the other average in reading achievement, were compared on laterality of function to determine whether or not it is related to reading disability

2. In eye dominance, as determined by a sighting technique, the control group (average readers) exceeded the experimental group (retarded readers) in the proportion of left eye dominant subjects.

3. Hand dominance, as determined by four motor skill tests and a group of unimanual choice tests, did not significantly differentiate the two groups Four experimental and two control subjects showed left hand dominance. Parents' statements of hand dominance of the subjects were in agreement with the results obtained in the test situations

4. In various combinations of eye and hand dominance, the two groups were essentially alike.

The findings of the entire study indicate that eye dominance, hand dominance, and hand versus eye dominance are not related in a primary way to reading disability of the degree represented here.

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DIFFERENTIAL FACTORS IN SPECIFIC READING DISABILITY II AUDITION, VISION, VERBAL ASSOCIATION, AND ADJUSTMENT*

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This paper reports a comparison of a group of subjects retarded in reading with a group of subjects average in reading on certain auditory and visual functions, fluency of verbal associations, and personal adjustment.[1] That inferiority in these factors may be causal in reading disability has been considered in previous investigations auditory acuity, memory, and discrimination (9, 14, 18), visual perception and memory (1, 4, 6, 9, 12, 16, 18, 19), and emotional adjustment (5, 9, 12, 13). Disparity of results reported in these studies may have been due to such factors as varying experimental procedures, absence of control groups in some instances and experimental groups not homogeneous in degree of reading retardation, in language background, in socio-economic status, in methods by which they were taught to read, in *IQ* and in *CA*.

The subjects for the study were 18 boys average in reading achievement (control group) and 18 boys retarded in reading (experimental group) who served as subjects in an extensive investigation of reading disability and who have been fully described elsewhere.[2] They were between the ages of 8 yrs 11 mos., and 9 yrs 11 mos., were average in intelligence, were from unilingual homes of middle socio-economic status, and had been in school an equal number of years.

A AUDITORY FUNCTIONS

The auditory tests included measures of acuity, discrimination, and memory span. Acuity was determined by the watch-tick method.

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*Approved for publication by Walter Miles, and received in the Editorial Office on October 14, 1939.

[1] This is the third of a series of articles reporting a study of reading disability presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Yale University in 1935.

[2] WOLFE, L S An experimental study of reversals in reading *Amer J Psychol*, 1939, 52, 533-561

The subject was seated with his back toward the examiner and was instructed to report at short intervals whether or not he could hear the tick. Three readings on a meter stick placed on the floor were made while moving the watch away from and three while moving it toward the subject. The Monroe *Auditory Word Discrimination Test* (14, p. 199) composed of 20 pairs of words to be recognized as "same" or "different" and the Gates *Test of Auditory Discrimination* (10, p. 401), consisting of five sets of nonsense syllables to be repeated, were given to appraise auditory discrimination. To test auditory memory span, the Gates *Tests of Auditory Memory Span* for nonsense-words, words, letters, and digits were used (10, p. 402).

The results are presented in Table 1. The experimental group was significantly inferior to the control group in the Monroe *Word Discrimination Test*. The inferiority of the former group on the Gates *Memory Span Test* for letters and Gates *Discrimination Test* approached statistical significance. On the remaining tests, while the experimental group's performance was poorer than that of the control, it was not significantly so. Grossness of the units and inadequacy of the upper limits of many of the tests are limitations upon the results. A determination of the number of subjects in each group who scored one or more years below their chronological ages on the

TABLE 1

MEAN SCORES ON AUDITORY FUNCTION TESTS WITH STANDARD ERRORS OF THE MEANS AND CRITICAL RATIOS, FOR THE EXPERIMENTAL AND THE CONTROL GROUPS

		Groups of subjects				
		Experimental		Control		
Tests	Scores	M	σ_m	M	σ_m	D/σ_d
Acuity (Watch tick)	Distance in cm	81.43	8.090	98.40	10.610	*1.27*
Discrimination						
Monroe	Errors	*2.11*	*323*	*94*	*153*	*3.28*
Gates	Age level	8.97	285	9.78	.181	*2.40*
Memory span						
Digits	Age level	8.42	.593	8.65	403	*32*
Letters	Age level	7.73	403	9.63	387	*2.83*
Nonsense words	Age level	8.86	412	9.74	257	*1.80*
Words	Age level	7.90	410	8.33	398	*75*

various tests revealed that the members of the experimental group were considerably more consistent in scoring low on the tests than were those of the control group (Table 2).

TABLE 2

NUMBER OF SUBJECTS IN EXPERIMENTAL AND CONTROL GROUPS WHO SCORED ONE OR MORE YEARS BELOW C. A. ON VARYING NUMBERS OF THE FOUR AUDITORY MEMORY AND THE TWO AUDITORY DISCRIMINATION TESTS

No. of tests on which subjects scored low	Tests and groups of subjects			
	Auditory memory		Auditory discrimination	
	*E**	*C***	*E**	*C***
4	4			
3	5			
2	4	7	3	
1	2	7	9	2
0	3	4	6	16

*Experimental group
**Control group

B. VISUAL FUNCTIONS

The Betts *Visual Sensation and Perception Tests* (2) and the Gates *Perception Tests* (10) were used in the comparisons of visual functions.

The Betts materials which were used were the Telebinocular and slides for measuring eight functions of sensation and perception, gross binocular vision; acuity, binocular and monocular; far-point fusion; near-point fusion; stereopsis, vertical imbalance; lateral imbalance; and ametropia. In addition, the slides for measuring oculomotor and perception habits by use of letters and numbers were used. The slides for determining acuity, stereopsis, horizontal imbalance and ametropia furnish measurements of degree of the function, the remaining slides give only "present," "absent," or "doubtful" responses but are adequate, however, for survey purposes. All subjects were tested in the mornings.

The results of all tests were expressed in percentages of subjects responding in given ways, except for the lateral imbalance test for which averages were computed (Tables 3, 4, and 5). For the sensation and perception tests the only difference found between the experimental and the control groups which approached statistical significance was in the proportion of subjects who had astigmatism in one or both eyes. Ten of the experimental subjects as compared

TABLE 3

PER CENT OF CONTROL AND EXPERIMENTAL SUBJECTS MAKING VARIOUS RESPONSES ON THE BETTS VISION TESTS

(The number of subjects in each group was 18.)

		Groups of subjects				
		Experimental		Control		
Tests	Responses	%	σ_p	%	σ_p	D/σ_d
1 Gross binocular vision	both fields	100		100		*0*
2 Far-point fusion	imperfect	33	11	11	8	*1 57*
3 Visual acuity						
Binocular	80%	6	6			*1 00*
	100%	83	9	94	6	*1 00*
	105%	11	8	6	6	*56*
Left eye	under 100%	17	9	17	9	*0*
	70%	6	6			*1 00*
	90%	11	8	17	9	*.50*
	100%	72	11	77	10	*40*
	105%	11	8	6	6	*56*
Right eye	under 100%	11	8	17	9	*48*
	80%	6	6	6	6	*0*
	90%	6	6	11	8	*.56*
	100%	83	9	77	10	*42*
	105%	6	6	6	6	*0*
4 Vertical imbalance	within average range	100		100		*0*
	perfect	83	9	83	9	*0*
	imperfect	17	9	17	9	*0*
	within tolerance range	89	8	89	8	*0*
5. Lateral imbalance	below tolerance range*	11	8	11	8	*0*
6 Stereopsis level	90%	11	8	6	6	*56*
	100%	89	8	94	6	*56*
7 Near-point fusion	perfect	83	9	78	10	*.38*
	imperfect	17	9	22	10	*.38*
8 Ametropia						
In left eye	myopia	11	8	11	8	*0*
	astigmatism	22	10	11	8	*.85*
	hypermetropia	50	12	56	12	*35*
In right eye	myopia	11	8	17	9	*50*
	astigmatism	39	12	22	10	*1 06*
	hypermetropia	39	12	44	12	*29*
In subjects (1 or both eyes)						
(*a*) any amount	myopia	11	8	17	9	*42*
	astigmatism	56	12	22	10	*2 43*
	pure astigmatism	17	9	11	12	*50*
	astigmatism and hypermetropia	39	12	11	12	*2 00*
	pure hypermetropia	22	10	50	12	*1 75*
(*b*) above normal amount	myopia	6	6	6	6	*0*
	astigmatism	11	8	6	6	*.56*
9 Irregularities of	fusion, astigmatism, myopia, acuity or imbalance	78	10	56	12	*1 47*

*See Table 4 for group averages

TABLE 4

COMPARISONS OF EXPERIMENTAL AND CONTROL GROUP ON LATERAL IMBALANCE TEST

Test	Groups of subjects Experimental M	 σ_m	 Control M	 σ_m	D/σ_d
Lateral imbalance					
At a distance equivalent of 13 inches	7.28	134	7.16	170	*56*
At a distance equivalent of 40 inches	4.07	153	4.12	219	*19*
40 in. equivalent-13 in. equivalent	3.21	134	3.04	156	*83*

TABLE 5

NUMBERS AND PER CENT OF REVERSAL RESPONSES ON THE BETTS VISION TESTS FOR THE EXPERIMENTAL AND THE CONTROL GROUPS

(The number of subjects in each group was 18.)

Tests	Groups of subjects Experimental N	 %	 σ%	 Control N	 %	 σ%	D/σ_d
Letter orientation							
Left eye (n = 252)	36	14	2	3	1	6	*5.65*
Right eye (n = 252)	25	10	19	5	2	9	*3.81*
Sum both eyes (n = 504)	61	12	15	8	2	6	*7.14*
Number orientation							
Left eye (n = 180)	3	2	10	1	1	7	*83*
Right eye (n = 180)	3	2	10	1	1	7	*83*
Sum both eyes (n = 360)	6	2	10	2	1	7	*1.11*

with four of the control subjects had demonstrable amounts of astigmatism. Of the former subjects, three had astigmatism only; seven had astigmatism plus hypermetropia. Two control subjects had astigmatism plus hypermetropia. The control group slightly exceeded the experimental in the number of subjects showing hypermetropia.[3] It should be mentioned that none of the subjects wore glasses.

On the oculomotor and perception tests of letter orientation the experimental group significantly exceeded the control group (Table 5) in the frequency of reversing letters viewed with the eyes separately and together. To determine whether or not there was any correspondence between the existence of a visual difficulty in one eye and the frequency of reversals by that eye, tabulations of the number of letters reversed out of 196 were made separately for the normal eye and for the eye designated by the tests as below normal The fourteen experimental subjects who had myopia, astigmatism, visual acuity under 100 per cent, poor fusion or imbalance reversed 30 letters with the weak eye and 18 letters with the normal eye. The number of letters reversed by the four experimental subjects with no visual difficulty was 13 for both eyes The few reversals which were made by the control group had no relationship to eye defects It appears from these data that visual defects may have some relation to the letter-reversing process, the evidence is not conclusive, however, because reversals occurred for eyes normal with respect to the visual functions tested. No significant difference appeared between the groups in frequency of number-reversals

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[3] Betts reported a "predominance of normal far-sightedness (hypermetropia) among preschool and primary children" (2, p. 33).

Ability to perceive small visually presented items was determined by the Gates *Series A, Same-Difference Series,* and *Series B, Selection Tests.* Gates terms the former perception tests; the latter, discrimination tests (10, p 259). The three tests comprising Series *A* are perception of differences between geometric designs, digits, and words. The response required by the subjects in each test is that of marking pairs of stimuli which are different. Series *B* consists of two multiple choice tests selection of geometrical figures, and selection of words identical with key items

Results for the groups in age scores are given in Table 6[4] The experimental group rated below the control group on every test. A reliable difference, however, was approached only on the test involving perception of differences in words

An examination of the scores for individual subjects was made to determine the incidence of individuals showing a consistent and sizable retardation in all the perception function tested by the Gates tests.[5] A grouping of the subjects in terms of their consistency in

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[4] In scoring the tests, extrapolation was necessary to obtain age ratings for the subjects who scored below the norms

[5] Among school children, Grades 3 to 8, having "serious difficulty" in spelling or reading, Gates found that none showed generally inferior perception on the perception tests (8, p 29) Fildes (7), Bronner (3), and Hincks (12) reported indications of somewhat general visual perception difficulties in reading disability subjects

TABLE 6

MEAN SCORES ON THE GATES *Perception Tests* OF THE EXPERIMENTAL AND THE CONTROL GROUPS, WITH THE STANDARD ERRORS OF THE MEANS AND CRITICAL RATIOS

(The number of subjects in each group was 18.)

	Experimental age scores		Control age scores		
Tests	M	σ_m	M	σ_m	D/σ_d
A_1*	8.79	535	9.19	.462	57
A_2**	8.59	398	8.98	318	77
A_{3+}***	7.74	.276	8.80	278	2.70
B_{1++}	9.17	438	9.61	.405	74
B_2	8.26	.280	9.07	247	2.17

*Perception of differences in geometrical designs
**Perception of differences in digits
***Perception of differences in words
+Selection of like geometrical designs
++Selection of like words

TABLE 7

NUMBER OF SUBJECTS IN THE EXPERIMENTAL AND THE CONTROL GROUPS WHO SCORED ONE OR MORE YEARS BELOW THEIR CHRONOLOGICAL AGES ON VARYING NUMBERS OF THE FIVE GATES *Perception Tests*

(The number of subjects in each group was 18.)

Number of tests on which subjects scored one or more years below *CA*'s	Groups of subjects Experimental	Control
5	3	0
4	5	4
3	3	2
2	2	4
1	3	2
0	2	6

scoring over one year below their chronological ages (Table 7) shows that three of the experimental subjects, in contrast to no control subjects, scored one or more years below their chronological ages on all five of the tests. On the other hand, only two of the experimental subjects, as opposed to six of the control, scored within one year of their chronological ages on all five tests

Gates lists two possible explanations for subjects' receiving low scores on all the perception tests (barring errors due to poor effort):

"(*a*) defects of the eye apparatus or (*b*) deficiencies in visual perception for small complex items" (10, p. 256). On the Betts visual examination administered in this study one of the three subjects scoring lowest on the Gates perception tests gave no evidence of any ametropia, another was myopic, and the other had a very slight amount of astigmatism in one eye. Any attempt to explain the low Gates perception scores of the latter two subjects solely on the grounds of ametropia seems unjustifiable in that other subjects showed some kind of ametropia and yet were not consistently low on the Gates tests. The last subject mentioned was an extremely phlegmatic individual, his low scores may have been a function of the short time limit on the tests.

C. Verbal Associations

Fluency of verbal associations was determined by counting the number of responses made in the verbal association section (Item 6 of the 10-year level) of the Stanford-Binet Intelligence Test, administered in the usual way.

The difference between the groups was not statistically significant, but perhaps the amount and the direction of the difference suggest a point for further study (Table 8). In general, the character of the verbal associations was similar for the two groups. Sixteen experimental subjects and all control subjects gave nouns predominantly. The other two experimental subjects gave only pronouns, prepositions, and articles.

TABLE 8

Mean Number of Free Association Words Given by the Experimental and the Control Groups in Three Minutes, with Standard Errors of the Means and Critical Ratio

(The number of subjects in each group was 18.)

Groups of subjects				
Experimental		Control		
M	σ_m	M	σ_m	D/σ_d
53.67	3.840	62.00	3.785	1.55

D. Personal Adjustment

The status of the two groups in personal adjustment was appraised in three ways. (*a*) Haggerty-Olsen-Wickman *Rating Schedules* were made out by each subject's teacher, (*b*) Woodworth-Cady *Psychoneurotic Inventories* were answered by the subjects; and (*c*) observations were made by the examiner of the children's reactions during the numerous test situations included in this study and the ones reported in previous articles.

The choice of the Haggerty-Olsen-Wickman *Behavior Rating Schedule* (11, 15, 20) was made with realization of the limitations of a personal rating technique. It is possible that at least some of the errors operative in such a technique occurred about equally in the ratings of the two groups and consequently did not necessarily vitiate a comparison of the groups. The existence of reading difficulty in the experimental subjects, however, probably influenced the teachers' ratings of those subjects on particular variables, e.g., intelligence. Schedule *A*, the *Behavior Problem Record*, consists of 15 items indicative of undesirable behavior; Schedule *B*, the *Behavior Rating Scale*, of 35 items, organized under four parts: intellectual, physical, social and emotional.[6]

The results for the two groups are given in Table 9. All the

TABLE 9

MEAN PERCENTILE RATINGS ON THE HAGGERTY-OLSEN-WICHMAN *Behavior Rating Schedules* WITH STANDARD ERRORS OF THE MEANS AND CRITICAL RATIOS, FOR THE EXPERIMENTAL AND THE CONTROL GROUPS

(The number of subjects in each group was 18.)

	Groups of subjects				
	Experimental		Control		
Schedule	M	σ_m	M	σ_m	D/σ_d
A *	51.78	6.751	28.22	5.079	*2.79*
B **					
Part 1	64.78	5.900	45.28	6.706	*2.18*
Part 2	55.50	7.573	42.22	7.498	*1.25*
Part 3	51.33	5.739	44.33	6.871	*.78*
Part 4	70.06	5.841	49.00	5.532	*2.65*
Total	65.56	6.246	49.44	5.897	*1.88*

*Behavior problem record.
**Behavior rating scale.
Part 1. Intellectual.
Part 2. Physical.
Part 3. Social.
Part 4. Emotional.

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[6] Reliabilities for the composite score have been found to be .86 to .95 for repeated ratings and from .77 to .94 with an average of .85 between halves and .92 for the whole (15).

differences were consistent in direction, the control group received percentile ratings indicative of better adjustment than did the experimental. *Differences between the two groups on the frequency of* behavior problems and on emotional maladjustments approached statistical significance. The categories of "lethargic," "uninterested," "a dabbler," and "difficult to keep at task until completed" were frequently checked as representative of the experimental subjects. A sizeable difference occurred in the ratings on intellectual behavior. It was noted in conversation with the teachers that most of them regarded the experimental subjects as poor in intelligence rather than as having reading handicaps.

The Woodworth-Cady *Psychoneurotic Inventory* (17), consisting of 85 questions, was administered to each subject individually. This procedure was necessary in the case of the experimental subjects since they could not read well enough to take the questionnaire alone and was duplicated for the controls in order to keep conditions constant for both groups.

That the groups did not differ in the number of responses indicative of maladjustment is shown in Table 10. It may be that the groups were equivalent in knowing the socially correct answers rather than in the characteristics which this questionnaire was designed to apprehend. Observations of the children in experimental situations contradicted an adjustmental equivalence. In addition, the questionnaire proved to be too difficult for the children. The examiner found it necessary to define a number of terms, an attempt was made to do so in as uniform a manner as possible. This procedure may have reduced the average incidence of maladjustment indicators until the group scores were roughly equivalent not only to each other but also to Terman's group of superior nine-year-old boys (17, p. 511).

TABLE 10

MEAN NUMBER OF RESPONSES ON WOODWORTH-CADY *Psychoneurotic Inventory* INDICATIVE OF MALADJUSTMENT FOR THE EXPERIMENTAL AND THE CONTROL GROUPS WITH STANDARD ERRORS OF THE MEANS AND CRITICAL RATIOS

(The number of subjects in each group was 18.)

Groups of subjects	M	σ_m	D/σ_d
Experimental	13.28	1.568	.02
Control	13.33	1.693	

As a third approach to the problem, the experimenter made a clinical evaluation of the reactions of each subject as he was observed under the various conditions of experimentation The subjects were classed in three categories in terms of the general clinical impression given (*a*) hyperactive, (*b*) average, and (*c*) underactive. Hyperactivity was defined as distractibility, over-responsiveness, a rapid flow of ideas frequently unrelated to the task at hand, and excessive movements Underactive reactions were in general the antithesis of the hyperactive Children who were classified in this category were slow in reacting, needed constant motivation and prodding in all activities and yet responded meagerly to them. Though such categorizing was less satisfactory than a finer gradation, it was felt that it might serve to show roughly the difference between the two groups when the same criteria were applied to both The number of subjects falling into each classification is given in Table 11 The experimental subjects in the hyperactive and underactive groups were more extreme in these reactions than were the so classified control subjects

TABLE 11

CLINICAL IMPRESSIONS OF GENERAL REACTIONS OF THE EXPERIMENTAL AND THE CONTROL GROUPS

(The number of subjects in each group was 18)

Reactions	Groups of subjects Experimental	Control
Hyperactive	4	2
Average	9	13
Underactive	5	3

On the whole the experimental subjects were less well motivated toward the tasks at hand than were the control subjects This was particularly true in situations dealing with school taught subjects but was also true in a vast number of other situations

Certain supplementary observations may be pertinent here One experimental subject had an eyelid tic; two, a rapid blinking of the eyes. Three showed decidedly hysterical reactions which were particularly pronounced in reading situations, two of them cried when confronted with reading material Two others were outstanding behavior problems in the school room and on the school grounds The incidence of subjects with badly bitten finger nails was seven in the experimental as compared with four in the control group

The inferiority of the experimental subjects in their emotional adjustments which had been noted by the teachers was thus corroborated in the clinical observations of the experimenter.

E. Discussion

No one of the functions investigated in this study was sufficiently characteristic of the retarded readers to be regarded as causative in reading difficulty. The significant differences between the groups of subjects on letter reversals and on auditory word discrimination are viewed as either concomitant with or results of reading retardation. A significant result of the study was the consistency with which the experimental group was inferior to the control group. The experimental group's performance was inferior to that of the control group on the majority of measurements made. Had it been possible to combine for each group of subjects the scores on the various performances, the cumulative scores would probably have differentiated the groups by a statistically significant amount. In general, the findings of this study are in substantial agreement with the results reported by Gates on large populations of New York school children (9).

Two main suggestions as to possible causes of reading disability of the degree represented herein arise from the results of this study. The possession of a number of undesirable characteristics, perhaps patterned in certain ways, may predispose to reading difficulty. The fair consistency with which the experimental group was inferior to the control makes such an interpretation possible. On the other hand, a single factor may have been causing both the reading retardation and the consistent inferiority of the experimental group on the functions measured. Clinical observations during the study indicated that in motivation the experimental group was, in the main, inferior to that of the control group. This factor may have contributed to the level of performance on at least the audition tests, the Gates *Perception Tests* and the free association task. A remaining possibility may be mentioned, namely, that the populations in the study were too small to reveal significant differences. It may be emphasized in this connection that although the groups were small, they were highly homogeneous as a result of the rigid selection process employed which achieved experimental elimination of a number of factors which larger unselected populations aim to equate.

F Summary

1. Two groups of nine-year-old boys, one retarded and the other average in reading achievement, were compared on functions which a number of previous studies have suggested as related to or causal in reading disability

2 On tests of auditory acuity, discrimination, and memory span, the experimental group was consistently inferior to the control group The difference was not significant statistically save in word discrimination

3 On the visual sensation sections of the Betts *Ready to Read Vision Tests* none of the visual functions significantly differentiated the two groups of subjects On the Betts "oculomotor and perception" tests of letter orientation and number orientation the experimental group significantly exceeded the control in reversals of the former but not of the latter. On the Gates *Perception Tests* the experimental group was consistently inferior to the control group but only approximately significantly so in discrimination of differences between words

4 Fluency in verbal associations did not significantly differentiate the two groups.

5 In emotional adjustment, as determined by clinical observations by the examiner and rating schedules filled out by the teachers, the experimental group was significantly inferior to the control group The Woodworth-Cady *Psychoneurotic Inventory* did not reveal this difference. The factors of attention and motivation as observed clinically appeared to be of great importance in differentiating the poor readers from the good readers

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The Journal of Genetic Psychology, 1941, 58, 71-82

SUCCESSIVE REPRODUCTIONS OF VISUALLY PERCEIVED FORMS*[1]

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A. INTRODUCTION

Karsten (10) found that the drawings of normal adults showed progressive distortions when they drew simple designs—for example pickets—continuously to the point of satiation. These distortions varied in nature and degree but were characterized by dissolution of the figures, conversions, omission of details, and by the acquisition of new configurations.

Based upon this early work, Curran and Schilder (7) requested normal individuals, Korsakoff patients, and schizophrenics to recall repeatedly a story of 24 items previously read to them until exhaustion and rejection occurred. They concluded that the distortions were not due to the fact that recalls were demanded, but that an active organizational process occurs in which the total personality is involved. In organic memory disturbances these processes are exaggerated and accelerated.

Bender (12) and Bender, Curran, and Schilder (3) have applied the Karsten technique to a variegated group of psychotic patients by asking them to draw continuously some of the original figures used by Wertheimer in his now famous study of perception. They found that "there is a correct grasp of the figure as a whole and its orientation on the background, with a tendency to some reversion to primitive responses and bizarre confabulation of the figure, without interference in the structure of the gestalt. . . ." (2, p. 428)

Fritsche (8) reports contrasting differences in the repetitive drawings of the Karsten type of manic-depressives and schizophrenics.

It would appear that an accurate evaluation of the configural

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*Accepted for publication by Harold E. Jones of the Editorial Board, and received in the Editorial Office on October 17, 1939.

[1] This paper is one of a series of studies by the senior author exploring the concept of satiation. Roma Tueller collaborated in this study by gathering the data for one of the two experiments reported here.

[2] Our debt to Professor Harold E. Jones is acknowledged by this brief note.

changes in the drawings of psychotics depends upon an understanding of their function in normal individuals. Young children are admirably suited for providing this understanding. We propose, therefore, to apply the technique of repeated reproductions (satiation) to young children and to study the reorganizations[9] which occur in the drawings in light of the child's symbolization.

B. EXPERIMENTAL DESIGN

The subjects for this study were 25 children attending the nursery school attached to the Institute of Child Welfare of the University of California. They made a total of 429 drawings during the course of study. These children were the oldest of the group: the mean chronological age was 46.9 months, and the mean mental age 56.34 months. Table 1 and Table 2 present the specific data for each child. On the whole, the subjects were from a somewhat superior environment and indicated superior intelligence.

TABLE 1

CHRONOLOGICAL AGE, MENTAL AGE, NUMBER OF REPRODUCTIONS, AND TEMPORAL PERIOD TO BECOME SATIATED, FOR SUBJECTS PERCEIVING ORIGINAL ONLY DURING INITIAL REPRODUCTION (GROUP I)

Subject	*CA**	*MA*	Number	Time
Ta	42	43	19	11'33"
Bb	44	52.55	15	12'
Na	54	64.42	7	12'6"
Ce	50	56.76	10	15'
Nc	42	49.67	11	3'21"
Ew	51.5	60.28	7	7'37"
Gr	51	72.07	34	38'21"
Taa	43	45.01	25	18'14"
Mo	47	53.82	17	9'43"
Ee	46	70.68	6	6'49"
Bn	41	52.04	12	9'30"
Mean	46.5	56.39	14.82	13.23'
Range	41-54	43-72.07	7-34	3.35'-38.35'

*In months.

The experimental directions were formulated in a simple manner

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[9] In a former study the term *creative substitutions* was applied as representing the conversions, distortions, and other mechanisms which arise with the onset of satiation and tendency to leave the field. In the following discussion we shall use the abbreviated term *substitutions* to apply to the reorganization in the reproductions appearing with satiation.

TABLE 2

CHRONOLOGICAL AGE, MENTAL AGE, NUMBER OF REPRODUCTIONS, AND TEMPORAL PERIOD TO BECOME SATIATED, FOR SUBJECTS HAVING ORIGINAL IN CONSTANT FIELD OF VISION (GROUP II)

Subject	*CA**	*MA*	Number	Time
Iel	57	82	30	16'56"
Bl	50	61.48	25	14'18"
Fr	50	56.76	23	14'24"
Ti	55	68.11	4	6'25"
Ca	56.5	67.51	13	7'5"
Ta	55	62.34	20	17'25"
Fi	54	71	8	8'44"
Yi	41	42.25	46	18'33"
Ka	45	51	8	5'52"
Cai	44	51.97	13	11'5"
Ko	32.5	38.05	24	18'56"
Tal	38	46	16	9'43"
Ku	38	38.63	23	15'25"
Mean	47.38	56.34	19.46	12.68'
Range	38-57	38.63-71	4-46	6.42'-18.93'

*In months

so that they might be easily comprehended by the children. No child was drafted as a subject unless he indicated his willingness to draw, and a friendly spirit prevailed throughout—consistent, however, with experimental control.

The subject was shown a drawing consisting of a circle drawn by hand containing three dots within the circumference (Figure 1). The configuration was such as to suggest a face or moon. The child was asked what the picture looked like. The response was invariably a moon, a face, a "punkin." The subject's attention was carefully drawn to the original. He was asked whether he could draw one exactly like "that one." Then he proceeded to make a replica with black crayon.[1] When his drawing was finished he was asked whether it was similar to the original. The original was removed and the subject made another reproduction with the instructions to make it like the one shown him. Only one drawing on a sheet was permitted. He was told that he could draw as many as he liked. Before each new reproduction the original was recalled verbally by the experimenter. The children soon learned to reach

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[1] Two children of the group refused to draw in the experimental situation, although they had previously announced their intention to draw. Their activity is not included in the data offered in this paper.

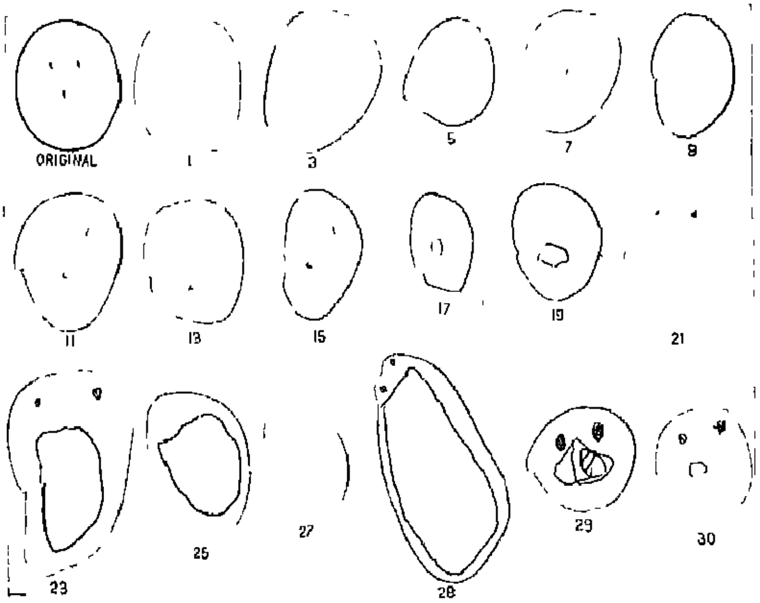

FIGURE 1
SAMPLING OF SUCCESSIVE REPRODUCTIONS BY A 57-MONTH-OLD GIRL WITH THE ORIGINAL IN CONSTANT VIEW

for a new sheet voluntarily when they had completed a drawing. The reproductions continued until the child expressed a desire to stop, or actually refused to draw any more, i.e., he was satiated.

The rejection was not due to toilet needs, fatigue, or sleep, since these factors were to a great degree controlled in the following fashion: (*a*) The subjects were taken to the toilet before the trials were begun; after rejection of the task they were asked whether they needed to go to the toilet. (*b*) All of the children played actively at a variety of tasks in the nursery following the trials. (*c*) No child who appeared sleepy was taken as a subject, and no subject succumbed to sleep during the trials, or immediately after.

The experimental procedure given directly above involves to a great extent the reorganization of memory traces, for the child sees the original only in his replication of the first drawing, and thereafter his drawings are expressions of his personality and traces of the original. It was desired to determine, in addition, the child's responses when he was confronted by the original each time a drawing was made. Thus the experiment was divided into two aspects. The second aspect (Group II) differed from the first only in the respect that the child had the original before him for every reproduction, whereas for Group I it was only recalled verbally after the first replication.

C. TREATMENT OF DATA

The protean nature of the reproductions almost defies quantification. But since our objectives are primarily fostered by a more qualitative analysis, we shall be content with a demonstration of any principles legitimately derived from such a procedure.

Table 1 and Table 2 summarizes the number of reproductions made by each child until satiation produced rejection. The corresponding temporal interval required to draw the series of reproductions is given in the same table.

The subjects of Group I drew a mean of 14.82 reproductions before they became satiated. The mean time to draw these 14.66 reproductions was 13.23 minutes (Table 1). The mean number of reproductions for Group II was 19.46 and the time to produce these 12.68 minutes. It should be considered that wide individual differences are apparent and the mean represents no actual score. The range of the number of reproductions for Group I was 7 to 34, the range of temporal intervals, 3.35 minutes to 38.35. For Group II the range of the number of reproductions was 4 to 46, and the range of temporal intervals, 6.42 minutes to 18.93 minutes.

In both experimental situations in question (Group I and Group II) all of the children made fairly accurate replicas in their first drawings. In some instances the circle was not as even as the original, but we are not concerned here with drawing ability per se—rather with the symbolic value of the drawing. It cannot be justly claimed that the reorganizations which arise during the course of the activity are due to any inadequate perception of the original, an inability to represent physically conceptual data, or unfamiliarity with the concepts of moon, face, or "punkin." More fundamental factors are at work.

It is to be expected that the drawings proximally consequent to the original should indicate the essential characteristics of the original to a greater degree than those more distal. This simply means that with the increase in the number of reproductions of the same original, the reorganizations become more frequent—in the form of a gradient Figure 1 represents a series of reproductions by a girl of 57 months with the original in view for each drawing (Group II). Since 30 drawings were made before becoming satiated, only alternate drawings are represented[5] Systematic examination of the drawings demonstrates a gradient For the first 15 drawings a stereotype is evident, but thereafter the nose (her term) grows in proportion, after a single Regression 21 In Reproduction 28 the nose has become so immense that the eyes are forced to the extreme cephalic end. *The nose indicates an autonomous existence,* for it has assumed the distinction of a face rather than a dependent element, and only its inclusion within the face prevents complete autonomy In the next Drawing 24 the drawing has returned to normal size, the eyes are more prominent and the nose, although not so gigantic, is more complex Reproduction 30—the final one—is more analogous to the original The subject felt no necessity of supplying a mouth either to her own drawings or to the original It seems that while a gradient in the degree of reorganizations was demonstrated, it was not a strict gradient for certain distal reproductions were more analogous to the original than certain proximal ones

The series of reproductions described above are atypical in the degree of *stereotype* manifested. *Stereotypes* are surprisingly infrequent, even though the attention is drawn to the original before each drawing. Consider (Figure 2) the reproductions of a girl of 54 months of age, who saw the original only once (Group I) No drawing is identical to the one preceding it. No 1 duplicates the original, No 2 shows prominent eyes and a strange nose, No 3 is supplied with a large mouth, as well as a nose, in an elongated face, in No 4 the face is smaller, but the nose is left out, No 5 has an incomplete body supplied to the face—the face is, however, only structured with eyes and eyelashes, and the figure stands—*functionally unconnected* (*asyndesis*)—upon a primitive base; Reproduction 6 attempts to elaborate former structurations, but the attempt is uncompleted and negated by hatchings across the figure, No 7 is the culmination of the drawings and is an elaborate representation of a man on a "lawn" ("different kinds of lawn")

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[5] The final three products are given in series

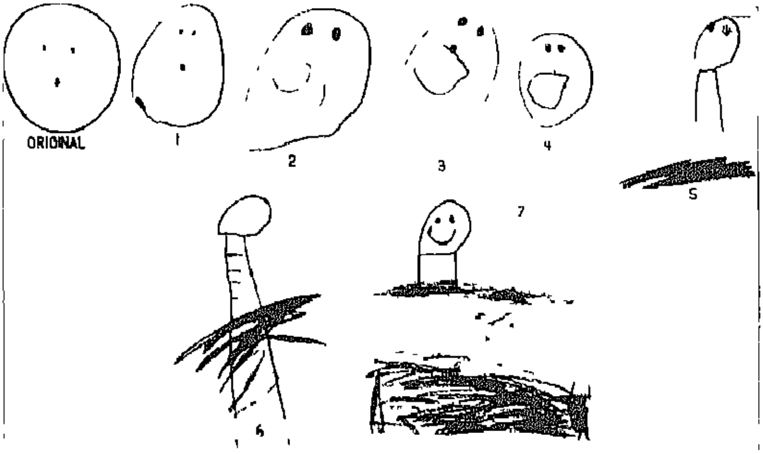

FIGURE 2
Successive Reproductions by a 54-Month-Old Girl, with the Original Seen Only During the First Reproduction

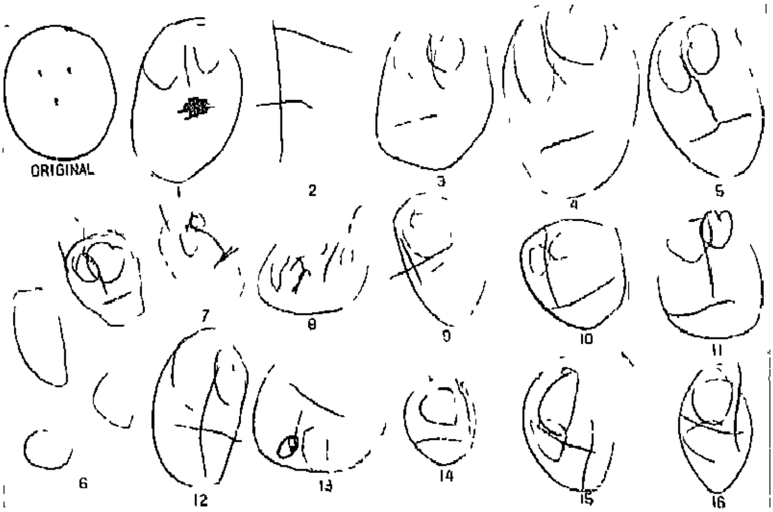

FIGURE 3
Successive Reproductions by a 47-Month-Old Boy, with the Original Seen Only During the First Reproduction

It is certain that a gradient holds for the successive drawings of our children. Memory studies have shown that recall is less distinct with longer temporal intervals there is not, however, a strict gradient, for regressions occur The children of Group II oscillated between producing replicas of the original and departing from the task by free expression

Figure 3 presents the reproductions of a boy (Group I) of 47 months of age It is seen that the subject has a definite conception of what his drawings should be like even though he is copying the original directly He supplies a mouth, and the nose is represented by a line between two large eyes. The mouth is a patch of crayon In No 3, where the original is no longer in the field of vision, the face loses its boundedness and the structuration is like a large *F* By studying the distal reproductions, we can see that this is a primitive structure which later resolves into mature configurations, and then becomes distorted The following three drawings, Nos 3, 4, 5, are to some degree *stereotypes* of No. 1, but the influence of No. 2 is discernible. In Nos 6 and 7 the drawings assume more the proportions of a human face hair is drawn on the top, a nose and mouth are present in some perspective; No 6 contains three uncompleted figures accompanying the mature reproduction The reproductions following this one show all degrees of reorganization and distortion Components of the structure are withdrawn, spatially relocated, exaggerated, and reclassified. With satiation, the drawings resemble only in slight fashion the original or the subject's copy of the original. The subject, however, insists that it is a moon and the same as the original.

Cameron (5) has pointed out that it is unfair to expect a drawing from a child that is complete in narrative fashion (in the sense of an artist's portrait) The child draws what is functionally significant for him in light of his history and immediate *presses* There is no question of absolute reality in the sense of true objectivity The face he has just drawn is objective for him, even though it looks to us neither like a moon nor a drawing That the child's drawing changes from period to period does not militate against this argument, for it is only natural that change should occur in new momentary situations with new *presses* There are *anchoring points* in every child's drawing which occur again and again, for although parts of the configuration are reconverted—and new additions made—a fundamental trace remains which serves as a core What is important is that the child's own symbolism undergoes such severe reorganization.

It is possible at this point to summarize the salient features of the children's reproductions under several rubrics

1. Reorganizations occur in the drawings of all of our children Following Wulf (12), we can think of these changes as *sharpening* (*Prazisierung*), *leveling* (*Nivelierung*), and *preserving* (*Normalizierung*) In other words, structures within the boundedness (moon) become more precise or exaggerated, preserve their status, or become diminished All of these processes function throughout a series of reproductions, and all may appear in any one reproduction

2 Reorganizations—as indicated by Allport (1, p 143)—seem to come from within The same stimulus evokes at different moments diverse end-products

3 Generally, the tendency to *sharpen, level,* or *preserve*—in reference to a specific structure within the boundedness—will continue when initiated until the satisfaction of the quasi-need, or to the creation of a new reorganization

4 A tendency for increased complexity rather than for simplicity was evident The reproductions acquire accoutrements and meaning with successive attempts, and an increase rather than a decrease in the size of the reproduction appears more the rule Regressions in size appear, and there are many exceptions to the rule

5 The disintegration of the wholeness of the configuration was not as great as reported by Karsten for her subjects This can be explained by the greater boundedness and tendency to cohesiveness of our figure (circle) and the relatively benign state of satiation by our subjects

6. A comparison of the initial reproductions with the final ones indicates that the reorganizations become more frequent in the later stages Reproductions made in a satiated state are usually more disorganized than when no satiation is present

7. The above factors operate similarly when the original drawing is present in the visual field for every drawing.

D DISCUSSION AND SUMMARY

Experimental studies of the memory process have revealed that reproductions in temporal sequence engender dynamic reorganizations in the memory trace (1, 11, 12) The causal events in this process are still in dispute (6, 7) Irrespective of militant alignment, it appears that an organismic interpretation of our children's drawings is necessary[9] Many children supplied a mouth not only to their drawings but also to the original Statements as *"there ought to be a mouth"* were frequent Drawings were seldom left uncompleted; and there was evident a tendency to produce as good as representation as possible—within the limits of the reorganized symbolization The new reproduction expresses the organism in a new momentary state It is inadequate to speak of simple associations in a static organism The variegated nature of the substitutions implies a dynamically fluid and elastic organism

The unstableness of the plane of reality in the child and the poverty of social organization exaggerate the memory reorganizations found in adults. We are therefore not entirely unprepared for the discovery that *stereotype* is so infrequent and that the reproductions become disfigured at so early a stage The original in constant view serves only temporarily in delaying this process

The work of many of the previous investigators suffers from a deficiency which has caused them to overlook an important variable It has remained for Karsten to reveal the implications. The act of repeatedly reproducing a perceived form soon leads to satiation The individual in such a state seeks to leave the field to avoid the task that has now become annoying His aspiration level may force him to persist but he develops mental mechanisms in the form of fantasy, hyperactive motor expression, and cyclical emotional states These are substitutions When they fail to relieve the situation the task is rejected This was found to be the case with adults as subjects on a punch-board maze (4).

The child finds it discomforting to replicate a drawing innumerable times. He soon becomes satiated. The *aus dem Felde gehen* influence of satiation supplanted by the natural tendency of the child to creativeness produces a monstrosity as an end-product Frequently the last drawing is a blob of black pencil or supercharged with a gigantic *X*.

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[9] This generality does not of course confine us to a strict acceptance of *pragnanz* as announced by Wulf or Kohler. Allport's (1), description of the reproductions (at two weeks and four months) of his pre-adolescent children indicates the existence of some basic commonality in the causal sequences of his investigation and ours His acceptance of the dynamic properties of the trace adds credence to our view

Nor is there much comfort in the fact that having the child fixate the original before every drawing has little inhibiting effect. The subject oscillates between the original and his free expression and finally succumbs to the latter. To our interrogation of the similarity of the original and his distortion, the child replies in all his naiveté that it is exactly the same. At other times the child is surprised at what he has conceived and supplies rationalizations when he is pressed for interpretation.

The evidence justifies the interpretation that satiation accentuates and distorts the normal process of graphic symbolization in the child. If carried to sufficient limits a monstrosity results which is meaningless even to the child.

It is suggestive that the reorganizations exhibited by our children differ little from those reported for the Korsakoff patients reported by Bender, *et al.* (3).

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The Journal of Genetic Psychology, 1941, 58, 83-111

DEVELOPMENT OF NEURO-MUSCULAR MECHANISMS AS REFLECTED IN THE CRAWLING AND CREEPING BEHAVIOR OF THE HUMAN INFANT*[1]

The Normal Child Development Study of the Department of Pediatrics, Columbia University, and the Babies Hospital

MYRTLE B. MCGRAW

Too often behavior is thought of merely as response to external stimuli Changing configurations in a neuro-motor behavior, especially the organic patterns common to the growing infant, can also be regarded as a reflector of the maturational changes taking place in the neuro-muscular mechanisms. The course of neuro-muscular development is clearly evident in the sequential changes of prone-progressive behavior of the growing infant

From studies of the structure of the nervous system of the human fetus and the newborn infant as conducted separately by Dr Frederick Tilney (8) and Dr J LeRoy Conel (3) the preponderance of evidence indicates that the human cortex is not functioning appreciably at the time of birth Dr Tilney has pointed out that during ontogeny there are three major phases in the development of the cerebral cortex as follows. (*a*) General cortical differentiation which is characterized by a series of migratory laminations, resulting in a six-layered neo-cortex (*b*) Divisional cortical differentiation which marks the period when the bulbar cortex, the paleo-cortex, the archicortex, and the neo-cortex may be structurally defined, though their cellular structures are too immature to permit decisive regulations of behavior. (*c*) Local cortical differentiation which is represented by the gradual changes taking place in the arrangement and disposition of the cells, resulting in highly specialized regions being directly concerned with specific functions

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*Received in the Editorial Office on October 21, 1939

[1] Members of the Staff of the Normal Child Development Study contribute appreciably to all publications of the writer. In this connection specific mention should be made of my indebtedness to Dr A P Weinbach for his suggestion of the plus-minus rating system, to Robert S Childs and Dana J Crandall for calculations of the data, to Kenneth W Breeze for the drawing of illustrations, and to Vera Dammann for assistance in recording and rating original data

Tilney further points out that there is no local differentiation in the neo-cortex of the infant at birth For the purpose of comparing structural development with behavior, Dr Tilney (8) draws a distinction between two types of behavior (*a*) cortical and (*b*) nuclear Behavior which is governed by the cortex is purposive, there is a latency and planned element in the response, in contrast to the sudden turn-over of impulses and the immediacy of reactions governed at the nuclear level Structurally the two divisions are differentiated by the size, shape, dendritic processes of the cells, and their precise and orderly arrangement in the cortex as contrasted with the way in which the nuclear cells are clustered together without definite distinction or order These nuclear regions are more primitive parts of the hemisphere, and in ontogeny the cells in the nuclei mature and are ready to act much earlier than are the cells in the cortex.

Dr Conel (4), who has made an intensive study of the structural development of the human nervous system at the time of birth, uses the following features of structures as criteria in comparing degrees of development: (*a*) the size of the cell-body, presence of neurofibrils, size and length of cell-processes; (*b*) number, size, and length of horizontal and vertical fibers in the cortex, (*c*) density of the neuropil in the various horizontal laminae, and (*d*) quantity of myelin present On the basis of these criteria he finds that the anterior central gyrus is the most advanced in development, and furthermore, the particular area in the anterior central gyrus which governs movements in the neck and shoulder is more advanced than any other region in the gyrus Dr Conel points out that the "Betz cells are the largest and most numerous in the middle one-third of the posterior wall of the anterior central gyrus," this area being the one which governs movements in the region of the trunk, upper extremities and head, moreover, "the processes of the Betz cells in the region of the upper trunk and shoulders are in a more advanced state of development than those of any other cells in the anterior central gyrus" Likewise there is more myelin in the middle one-third of the posterior wall, i.e, in the region governing the upper trunk, than in any other part of the anterior central gyrus "The anterior central gyrus is more advanced in development than the posterior central gyrus and these two gyri are the most advanced in the entire cortex Furthermore, in the anterior central gyrus the functional area for movements in the neck and shoulder is more advanced than any other region in this gyrus."

Whatever criteria are used for estimating development in the structure of the cerebral cortex, the preponderance of evidence indicates that the most advanced stage is found in the region controlling muscular activity involving the cervical and thoracic spine together with that of the upper extremities. Likewise in behavior, the earliest signs of cortical activity are found to be in those parts of the body.

When considering the development of a behavior activity like crawling and creeping, especially as it relates to the maturation of neural structures, the following items should be borne in mind. (*a*) It is necessary to distinguish, at least qualitatively, those motor activities which are governed at a nuclear, or subcortical, level from those which are definitely under cortical influence. Cortical behavior is deliberate in quality and shows organization of several neural mechanisms. (*b*) The cortex, as it develops, not only takes on a controlling influence over muscular activity, but it also exercises an inhibitory influence upon many muscular activities which are governed at a nuclear level. (*c*) The trend of development in both the nervous system and motor behavior follows a cephalo-caudal course.

An analysis of the changing behavior pattern of the growing infant as he progresses from the newborn reflex phase to the final stage of integrated creeping will elucidate these points. The present analysis is based upon a study of 82 infants in their achievement of prone progression. Observations were made on each child at weekly, bi-weekly, or less frequent intervals, the total number of observations on the entire group (exclusive of a program of daily observations for a longitudinal study on four different babies) amounted to 1,777. Of this total 442 were recorded in motion picture film, and 1,135 consisted of written protocols. A total of 5,815 feet of movie film was exposed in these crawling and creeping records. Daily records, four or five days a week, were made on four different infants for the purpose of accumulating longitudinal data on the sequential development of this same type of behavior. The data on these four children will be treated individually.

On examining the mass of records it appeared possible to select nine distinct phases in such a way that any child could be rated, regardless of his individual peculiarity in creeping, so as to reflect

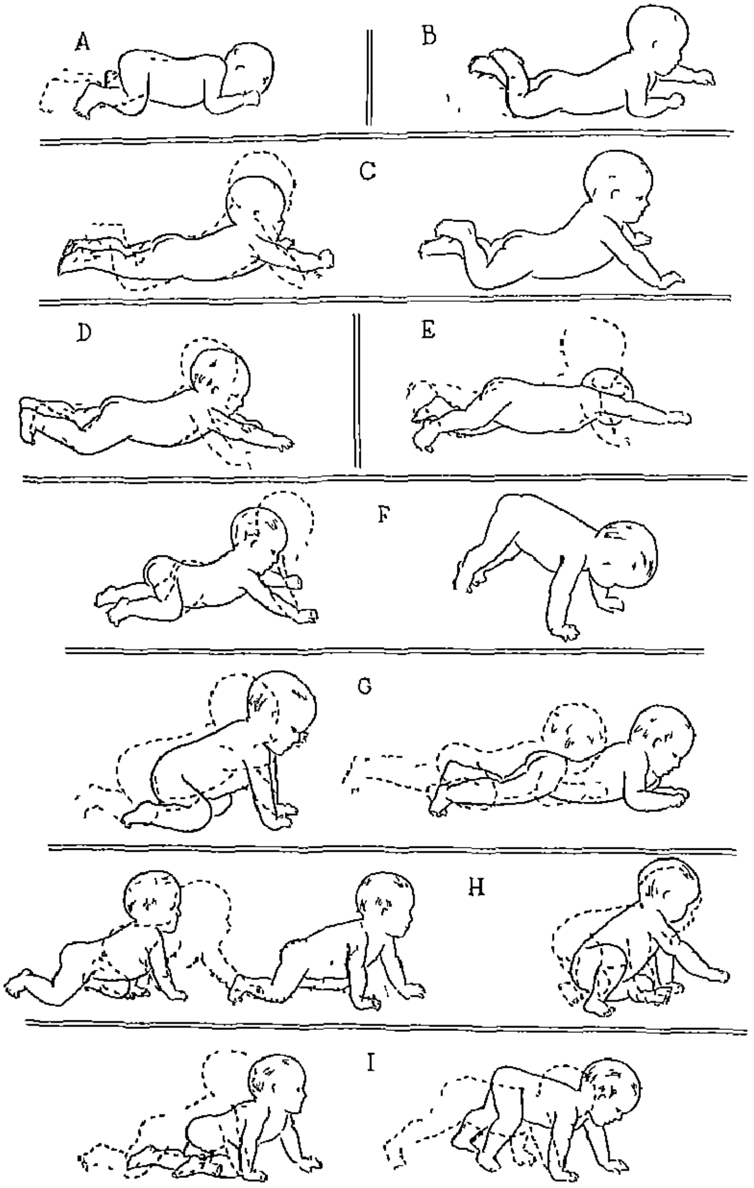


FIGURE 1
LINE DRAWINGS ILLUSTRATING NINE PHASES IN THE DEVELOPMENT OF PRONE PROGRESSION

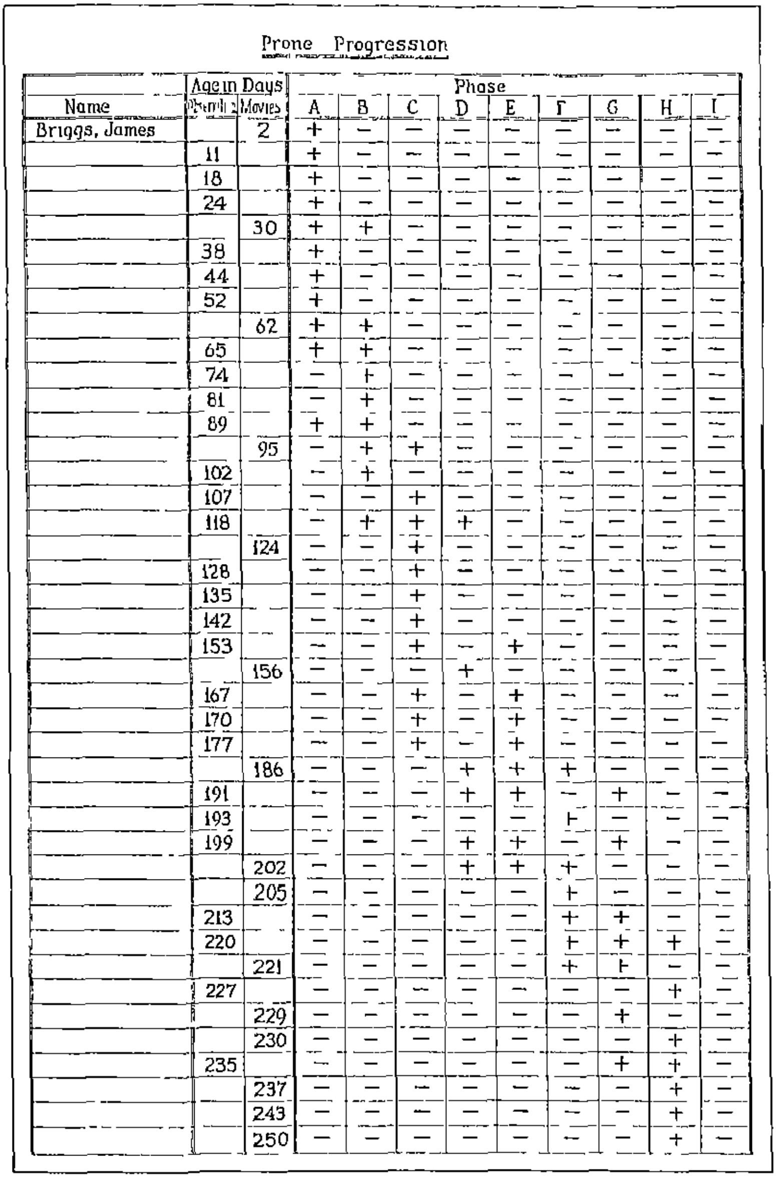
the essential advancement in his neuro-muscular maturation These phases are illustrated in Figure 1 of the line drawings which were obtained by tracings of the cinema projections The nine phases became apparent only after a rationale, based upon a theoretical interpretation of the maturation of the nervous system, had been realized The original data consisted of descriptive notes of somatic movements made by the baby in an effort to progress Obviously the posture and movements of the newborn infant are different from those of the creeping baby Moreover, there are certain consistencies in the changing configurations of posture and movement as the babies achieve progression, or attempt to do so Along with these consistencies in developmental changes there are also noticeable individual peculiarities One baby creeps on his abdomen, another on palms and knees, while still another runs about as a little quadruped The problem was to reduce descriptive material of this order to some sort of symbolic system so that the data could be manipulated and interpreted A basis for selecting the nine phases in the development of prone progression was found not only in the changing configurations of somatic movements but also in a theoretical interpretation of neuro-somatic functioning After various efforts to organize the data into categories based upon descriptions of overt motor activity only, it was realized that in many instances verbal descriptions of only motor movements may read essentially the same for both voluntary and involuntary activities For example, it may be recorded that the baby who could not stand alone would, when supported in the erect position, make progressive stepping movements Such descriptions will not, however, differentiate the stepping movements of the newborn from those which appear just prior to independent walking Moreover, it was also recognized that two babies may engage in movements which in pattern appear to be different but in fact reflect the same level of neuro-maturation If categories are based entirely upon descriptions of somatic movements it is infeasible to cover the multitude of movements which one child, much less a whole group, might manifest While it is virtually impossible to verbalize all those qualities which distinguish a flexor movement of the reflex level from one of cortical control, there is no doubt that the moderately experienced observer can recognize such differences Evidence that differentiations of this order can reach a fairly high level of reliability will be presented later in this paper The nine phases or sequences which have proved helpful in analyzing and understanding the development of creeping have therefore been defined partly in terms of description of bodily movements and partly in terms of the demonstrated ability of an observer to separate outwardly similar types of somatic activity The manner in which the nine phases have been used in the analysis is simple Each observation during the period of learning to creep was classified as plus under the phase most accurately descriptive of the stage of development achieved and as minus under the remaining eight phases. From time to time, as will appear, more than one phase was marked as plus but the larger number of phases was always negative. This method of scoring we have termed the plus-minus system

A copy of a data sheet (Figure 2), covering observations made during the first 250 days of a child's life illustrates the way in which these ratings were recorded. The basis upon which they were made will be clarified by the following detailed analysis of identifying features of each phase

CRITERIA USED IN RATING NINE PHASES OF PRONE PROGRESSION

1 *Phase A· Newborn Posture and Movements*

The first picture in Figure 1 represents the posture and movements characteristic of the newborn infant It should be recalled that the human cortex has two outstanding functions: (*a*) inhibitory influence upon activities of a lower level, and (*b*) a controlling influence upon motor movements. It should also be recalled that at the time of birth, although the cortex is not functioning to any appreciable degree, the most advanced cortical development is in that part of the motor area which governs the cervical spine and the upper extremities. That neuro-muscular maturation tends to be in a cephalo-caudal direction should be borne in mind This last tenet especially may seem to be a little confusing when one first observes the activities of the newborn baby placed in a prone position His general posture is one of flexion Ordinarily his face or cheek will rest on the surface, except for an occasional bobbing of the head; the upper extremities are flexed and held close to his body. The lower extremities are likewise held in a degree of flexion so that the crest of the ilia do not rest on the underlying surface Often there is a marked degree of activity in the lower extremities Rapid



Prone Progression

Name	Age in Days		Phase								
	[illegible]	Movies	A	B	C	D	E	F	G	H	I
Briggs, James		2	+	–	–	–	–	–	–	–	–
	11		+	–	–	–	–	–	–	–	–
	18		+	–	–	–	–	–	–	–	–
	24		+	–	–	–	–	–	–	–	–
		30	+	+	–	–	–	–	–	–	–
	38		+	–	–	–	–	–	–	–	–
	44		+	–	–	–	–	–	–	–	–
	52		+	–	–	–	–	–	–	–	–
		62	+	+	–	–	–	–	–	–	–
	65		+	+	–	–	–	–	–	–	–
	74		–	+	–	–	–	–	–	–	–
	81		–	+	–	–	–	–	–	–	–
	89		+	+	–	–	–	–	–	–	–
		95	–	+	+	–	–	–	–	–	–
	102		–	+	–	–	–	–	–	–	–
	107		–	–	+	–	–	–	–	–	–
	118		–	+	+	+	–	–	–	–	–
		124	–	–	+	–	–	–	–	–	–
	128		–	–	+	–	–	–	–	–	–
	135		–	–	+	–	–	–	–	–	–
	142		–	–	+	–	–	–	–	–	–
	153		–	–	+	–	+	–	–	–	–
		156	–	–	–	+	–	–	–	–	–
	167		–	–	+	–	+	–	–	–	–
	170		–	–	+	–	+	–	–	–	–
	177		–	–	+	–	+	–	–	–	–
		186	–	–	–	+	+	+	–	–	–
	191		–	–	–	+	+	–	+	–	–
	193		–	–	–	–	–	+	–	–	–
	199		–	–	–	+	+	–	+	–	–
		202	–	–	–	+	+	+	–	–	–
		205	–	–	–	–	–	+	–	–	–
	213		–	–	–	–	–	+	+	–	–
	220		–	–	–	–	–	+	+	+	–
		221	–	–	–	–	–	+	+	–	–
	227		–	–	–	–	–	–	–	+	–
		229	–	–	–	–	–	–	+	–	–
		230	–	–	–	–	–	–	–	+	–
	235		–	–	–	–	–	–	+	+	–
		237	–	–	–	–	–	–	–	+	–
		243	–	–	–	–	–	–	–	+	–
		250	–	–	–	–	–	–	–	+	–

FIGURE 2

TYPICAL DATA SHEET SHOWING THE RATINGS ON ONE CHILD DURING THE FIRST 250 DAYS OF LIFE flexor-extensor movements take place bilaterally or alternately, the toes sometimes in dorsi-flexion press against the surface with such force that the baby may actually push himself forward on the bed A degree of rhythmicity characterizes these movements Sometimes a certain amount of activity occurs in the upper extremities together with alternate lateral flexion of the trunk (5) But the observer *will be struck with the fact that much more activity is manifested in* the region of the hips and lower extremities than in the shoulder girdle and upper extremities This observation at first seems to be in contradiction to the alleged cephalo-caudal course of growth However, the quality and distribution of movements manifested by the newborn suggest that the amount of cortical development at the time of birth and during the first few weeks thereafter is sufficient to exercise a degree of inhibitory influence upon the nuclear activities in the shoulder and arm region, though it is insufficient to activate cortical movements in those regions At the same time cortical development in the region governing the pelvic girdle and the lower *extremities is inadequate to exert comparable inhibitory influence* upon subcortical movements For that reason both in amount and rhythmicity of movements the inferior region of the body of the newborn infant is more active than the superior regions This first phase, by arbitrary definition, represents the general posture and movements of the newborn infant A plus rating has been assigned to it when the infant shows the characteristic flexor posture whether or not he also engages in the rhythmical movements in the lower extremities, as both posture and movement indicate essentially the same stage of neural maturation

2 *Phase B Beginning Spinal Extension*

The second phase represents the beginning development of the extensor muscles and denotes a degree of cortical control over movement and posture especially in the region of the cervical spine By extension of the neck the baby is able to sustain his head in a lifted position for a little while (easily distinguishable from the bobbing which occurs in the first phase), there is less flexion in the upper extremities, and the activity in the lower extremities is of a random character in contrast to the rhythmical, better organized, lower level movements which occur in the first phase In addition to the beginning of cortical control over movement and posture in the superior regions, there is evidence of slight cortical inhibitory influence being exerted upon the nuclear movements in the region of the pelvic girdle and lower extremities If the baby happens to be in such a phase of development that during one observation he is seen to extend the cervical muscles, thereby lifting his head, but in the next moment drops the head and engages in the rhythmical movements characteristic of the newborn phase, the overlapping of the two phases has been indicated by assigning a plus value to both Phase *A* and Phase *B* If, however, the flexor-extensor movements of the lower extremities occur primarily at the knee joint, then only Phase *B* has been given the plus rating It is clear that the earliest manifestation of cortical control over posture and movement is indicated in the region of the cervical spine, thus bearing evidence of the cephalo-caudal course of neuro-muscular maturation In this phase, however, extension has not attained its ultimate development even in the superior region as can be noted by small details such as a tendency toward flexion of the digits, and the degree of extension in the superior spine and upper extremities

3 *Phase C Advanced Spinal Extension*

In the third phase the maturation of extensor functioning which governs posture has spread beyond the cervical region down to the muscles of the lumbar region By extension of the cervical and thoracic spine the head and chest are not only lifted higher but can be sustained in this elevated position for an indefinite period, the baby may support himself on the lower part of the forearm or on the palms and there is a noticeable tendency toward extension of the digits Extension in the pelvic region has progressed to such an extent that the crest of the ilia rest heavily on the surface, and the lower extremities are comparatively inactive. If the baby becomes interested in an object before him, he may release his support on the upper extremities, drop his chest, and engage in generalized diffuse activity As yet he shows no signs of cortical progressive movements in either upper or lower extremities This comparatively inactive phase in the region of the pelvic girdle and lower extremities would seem to reflect a transitional process from nuclear to cortical control over the musculature determining body position and movement, similar somewhat to the stage of development represented in the shoulder girdle and upper extremities during the newborn phase, It appears that whenever a transition from nuclear to cortical control is taking place there is a period of comparative inactivity in those parts of the body representing the areas in which the neural transition is occurring. In Phase *C* the neural development has advanced to such a stage that the nuclear rhythmical activity of the lower extremities is suppressed, and the extensor muscles of position are active so that the baby no longer shows the flexed posture of the newborn. The few movements he makes are diffuse and disorganized. He may pat the surface with his hands, or, resting on his abdomen, kick his legs and wave his arms in a random fashion, but he shows no distinct evidence either in shoulder or pelvic regions of an urge to move his body forward.

4. *Phase D: Incipient Propulsive Movements in Superior Region*

In Phase *D* when the child is at rest his posture may be the same as that ascribed to Phase *C*, the aspect of his behavior which differentiates Phase *C* from Phase *D* is indicated by the manifestation of an urge to move his body. That is, whatever the neural connections are which relate the baby's perception of external stimuli to his body sense these connections now come into play, and their presence is indicated in his behavior by an urge to move forward. In most infants this first manifestation of a progressive urge is expressed in the region of the shoulder girdle and upper extremities. Usually he releases his support on the arms, drops his head and chest, extends an arm forward and strains with the shoulder muscles. Sometimes his hands pull a little on the surface of the floor or bed on which he is lying. He is still unable to make progress, but the impulse to do so is indicated by the action of muscles in the superior part of the body. Usually the pelvis and lower extremities rest heavily on the surface. Sometimes the advanced development in the upper part of the body is expressed by swaying the shoulders from side to side as the infant supports himself on the palms with the upper extremities extended. Often the impulse to move his body becomes so exaggerated and the imbalance between inferior and superior development is such that he will actually move backwards as he pushes with his hands against the surface. Or he may pivot on his abdomen, flex the trunk at the waistline, and push with his hands against the floor until he turns completely around. These different configurations of movement merely represent individual or ephemeral peculiarities All are an expression of the neural connections between those centers which control muscles in the superior part of the body with the neural mechanisms which activate the impulse to move Any type of activity which gives evidence that such connections are being established has been scored plus in Phase *D*.

5 *Phase E: Incipient Propulsive Movements in Inferior Region*

In Phase *E* the cephalo-caudal course of growth is again revealed At this time the cortical centers which control deliberate movements in the region of the pelvic girdle and lower extremities show signs of maturing. At the same time pathways are being established which connect these motor centers with other cortical centers, particularly those governing (*a*) body sense, or an awareness of the position of bodily members in space and (*b*) those centers which control the baby's perception of his immediate external environment. This development is usually expressed in overt behavior by a deliberate flexor move of the lower extremity, usually raising the hip, and pressing against the surface with the toes in dorsi-flexion In the early stages of this development the baby may first exert all effort in the upper part of the body, as in Phase *D*, then release the strain there, drop his chest and push with a foot. Such activity has been given a plus rating in both *D* and *E*. But if the two movements are fairly well synchronized so that the exertion in the upper part of the body and that of the pelvic girdle and lower extremities occur practically together then he has been rated plus in Phase *E* only; likewise, if there is very little or no exertion in the upper part of the body during the time of observation he has been rated plus only in Phase *E*. The purpose of this phase is to bring out that, as a result of the connections between cortical centers controlling body sense, the increased response to external environment, and that strange thing called motivation, the impulse to progress or move the body from its spatial position is expressed by deliberate movements of muscles in the inferior part of the body. In both phases, *D* and *E*, according to the system of rating employed, the baby does not make any definite progress as a result of consecutive or synchronized movements of his bodily members

6 *Phase F: Assumption of Creeping Posture*

At this stage there is observed in most infants a pause or recession in the manifestation of a propulsive urge. Phase *F* represents primarily the coordination or integration of control over muscles of posture in both the shoulder and the pelvic regions. A plus rating has been assigned to this phase for any deliberate effort made toward maintaining the abdomen in a position raised above the surface The baby may rest on the palms, flex his thighs so that he is in a palm-knee position, but maintain it for only a moment; or he may exaggerate his effort by rising on his toes as he supports himself on the palms In such cases there is usually noticeable dyssynergia in the pelvic region. Another pattern characteristic of this phase is seen when, as the infant rises on his palms and knees, he rocks back and forth In any event he does not make deliberate moves to progress while the abdomen is raised above the surface Sometimes he may progress by losing his balance and toppling forward, rising again and repeating the performance, but since his progressive moves are not deliberate he has been rated plus in Phase *F* only. This period representing a definite effort to maintain a creeping posture before the onset of actual progression is the sequence observed in most infants. But, as the number of neural connections in any activity becomes more complex, there is greater opportunity for individual variation. Greater individual differences are, therefore, observed in the later phases of prone progression than in the earlier phases. These individual variations do not, it seems, alter the fundamental course of neuro-muscular maturation, but do reflect the manner in which a particular baby's nervous system is ripening, as will be shown in the discussion of subsequent phases

7. *Phase G Deliberate but Unorganized Progression*

When the baby achieves sufficient cortical control to make deliberate movements of upper and lower extremities in order to carry his body forward he has been rated plus in Phase *G*. The quality of movements which characterize this phase is the absence of an organized system for propulsion. The infant may raise one arm and place it forward, then the other arm, and follow it by a simultaneous flexion of both thighs, thereby bringing the knees forward in a hopping fashion. Two consecutive movements may be ipsi-lateral at one moment and contra-lateral the next His movements may be interspersed with long pauses or falls to the abdominal position, but he unmistakably has the idea of using his arms and legs for the purpose of propulsion. In a few children the propulsive urge is indicated before they have gained a creeping posture, as represented by Phase *F*. In such cases, they propel themselves across the floor with the abdomen on the surface. They make progress by pulling with the upper extremities and pushing with the toes against the surface even though they have to overcome the friction of abdominal, leg, and arm contact with the underlying surface. Such performances have been assigned a plus rating in both Phase *E* and Phase *G* except when the progressive movements are well integrated. Phase *E* indicates that the propulsive urge is expressed in the action of both upper and lower extremities though the baby does not raise the abdomen above the surface, while Phase *G* indicates that he actually makes progress for an appreciable distance. There have been one or two occasions when a child has been able, without any detectable use of the lower extremities for propulsion, to make progress with his abdomen on the surface. In such instances it appears as if the urge for propulsion has become dominant before adequate innervation is attained in the region of the pelvic girdle and lower extremities. In order to differentiate such performance, plus ratings have been recorded for both Phase *D* and Phase *G* provided the propulsive movements are incoordinate. It was considered reasonable to classify in one phase all instances of progression *per se* without regard to postural form since the progressive impulse is somewhat specific and may become grafted onto any postural form predominant at the time the urge to progress is manifest. This manner of classification is further justified by the observation that abdominal creepers[2] invariably develop a palm-knee, tri-pedal or quadrupedal method of creeping before they achieve erect locomotion. No baby has been observed to move directly from abdominal creeping to erect locomotion, though some do, for a while, develop a definitely integrated pattern as an abdominal creeper (see Phase *I*). However, as soon as the maturation of all neural centers involved is unquestionably complete the baby employs a more conventional mode of creeping.

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[2] Burnside (2) makes a distinction between "crawling" and "creeping"—in crawling the abdomen is in contact with the surface and in creeping it is raised above the floor. This definition does not differentiate the "crawling movements" of the newborn infant and the deliberate progressive movements of the older baby whose neural organization is definitely of a higher order.

8 *Phase H. Organized Progression*

The next phase represents not so much the maturation of new centers of control as the organization of these centers into a system. The baby begins to have a definite creeping pattern. He not only can travel some distance across the floor, but the consecutive movements are of essentially the same order. The most common method is the palm-knee position with contra-lateral associated movements of the upper and lower extremities. Although the movements are associated they are staccato, or isolated, in quality. The infant may lose his control and fall to the abdomen occasionally, but at once he is up and on his way again. That is, if he does lose control he quickly goes back to his system when he starts oft the second time. Some babies progress with support on the palms, the lateral aspect of one thigh, and one foot. As they advance toward a more integrated state they sit on the buttocks with one leg flexed, and manipulate the other foot and one hand for propulsion while the other arm swings out in extension and abduction. From the few children observed who have adopted this method the impression has been gained that the propulsive forces become manifest at the time the baby is developing a sitting posture and that the urge toward progression becomes grafted, as it were, onto the sitting posture. In any event such infants develop an organized system of progression and so long as their movements within their chosen system are staccato, or incoordinate, in quality, they have been rated plus in Phase *H*.

9 *Phase I: Integrated Progression*

The identifying distinction between Phase *H* and Phase *I* is that qualitative difference which demarcates a staccato, somewhat incoordinate, movement from a smoothly integrated performance. In Phase *I*, whatever movements are involved, they work together as if they were one. The child has been rated plus in this phase whether he moves on palms and knees, tri-pedal (one knee and one foot and both palms), or quadrupedal (hands and feet) provided all of the movements involved are working together harmoniously. If an abdominal-creeper develops a well integrated method then he has been rated plus on both Phase *G* and Phase *I*; *G* to indicate that the method is abdominal and *I* that the movements are well integrated. If he moves in an integrated fashion while sitting on the buttocks with one leg flexed and abducted beneath him, one arm waving as he propels himself forward with the opposite hand and foot, then he has been rated plus in both Phase *H* and *I*. The manner of rating these atypical methods of progression is reasonable since idiosyncrasy of the pattern may be interpreted to reflect some individual peculiarity in the sequence of neural maturation Once their neural maturation has achieved completion the babies who stabilize or integrate on a bizarre or atypical method employ the plam-knee or quadrupedal manner of creeping If they are induced to creep after they have begun to prefer erect locomotion then they do not call upon their old familiar developmental pattern, but instead get down and creep on palms and knees or on all fours In other words, it would seem that when all neural structures involved have arrived at an appropriate stage of maturation the function is expressed in classical form rather than the peculiar individual pattern manifested during the earlier stages of development

ANALYSIS OF THE DATA

Plus-minus ratings according to the criteria outlined above rendered the 1,777 observational records in symbolic form so that they could be manipulated and interpreted. Plus-minus values ascribed to an intricate growing phenomenon in this way are in a sense misleading because an all-or-none value is implied, when in fact no sharp lines of demarcation are evident in any growing process. In essence, the plus values occurring in these data mean merely that the stage of development described at the time of the original observations corresponds more nearly to one phase than it does to another. Even with this broad meaning as an operating definition, it still was sometimes necessary to plus two or more phases at the time of any given observation if the baby's behavior did not show some predominating or characteristic configuration.

The observational group data when scored on a plus-minus basis and plotted against chronological age yield the curves shown in Figure 3 These curves indicate the percentage of occurrence of each phase at any chronological period. They were obtained by computing for each phase the percentage of plus ratings for each 10-day interval After about 400 days the curve for Phase *H* begins to show a wide scatter. This scatter is attributed to the continuation of observations in the creeping activity for many of the children long

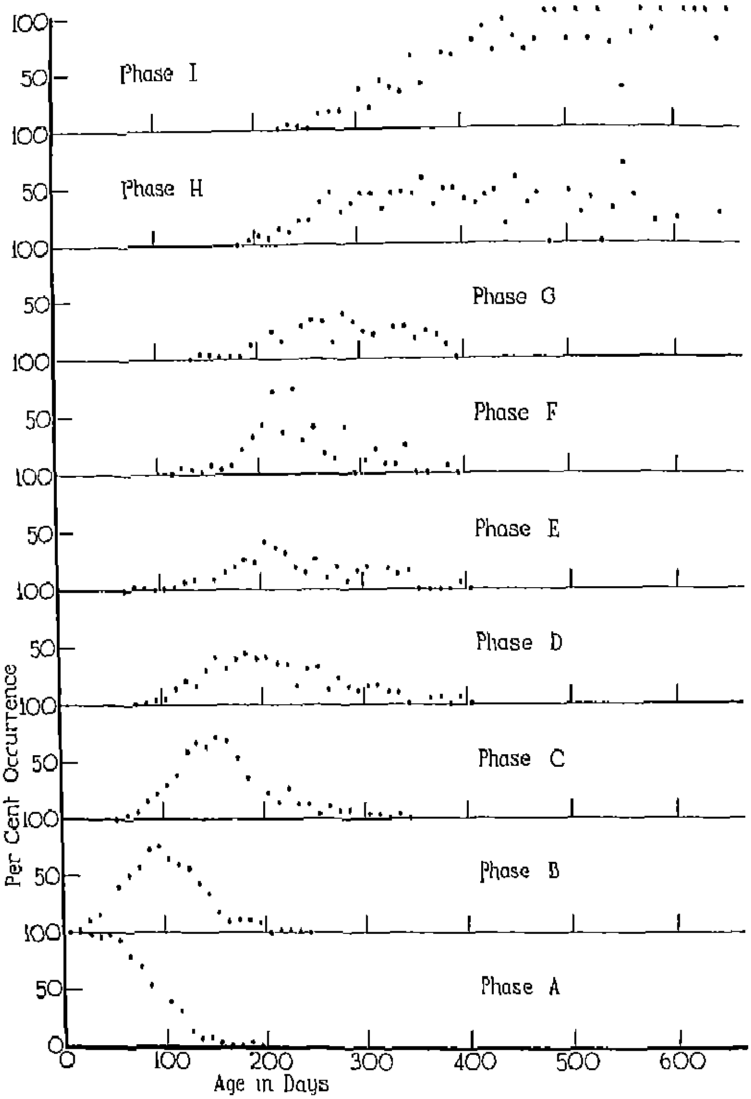


FIGURE 3

Curves Showing on a Chronological Scale the Percentage Distribution of Each Phase of Prone Progression as Manifested by a Group of 82 Infants

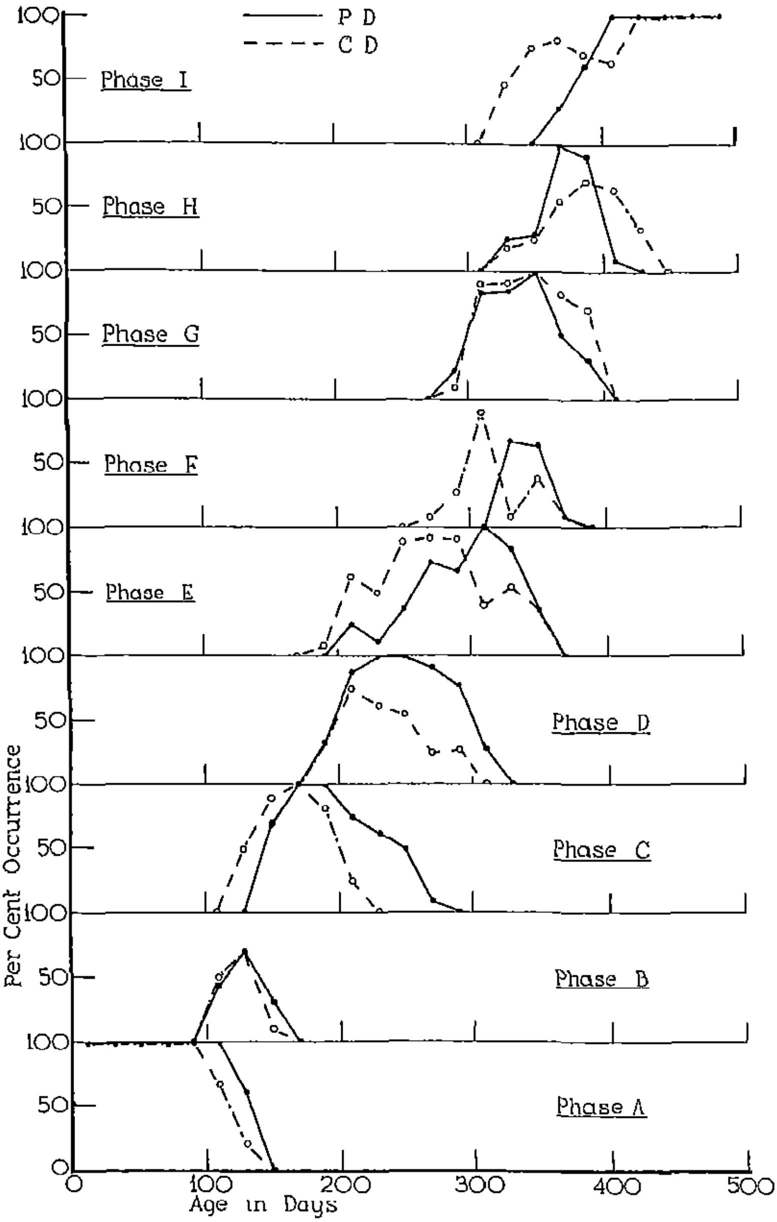


FIGURE 4

The Age Distribution of Each Phase of Prone Progression as Manifested by Identical Twin Boys after they had begun to prefer erect locomotion. After the child has achieved independent walking he often shows greater incoördination in the creeping behavior than he did during the period when creeping was his chief means of locomotion. These older babies were scored plus in Phase *H* even though it was not the same kind of incoördination which occurred when they were in the process of developing a creeping pattern. If the study of creeping is terminated at the time erect locomotion becomes preferred, then the

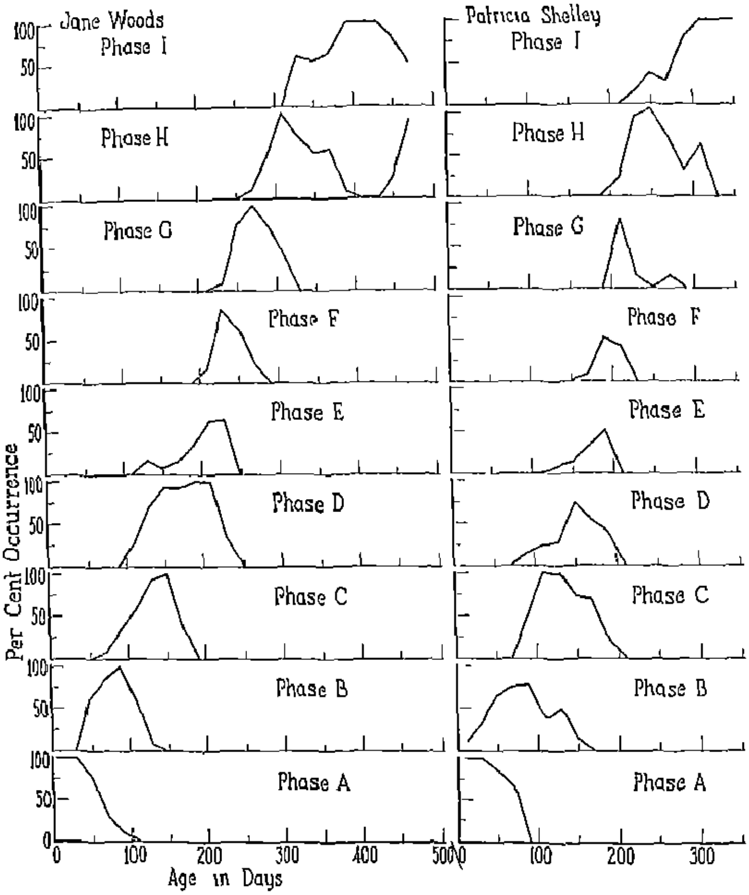
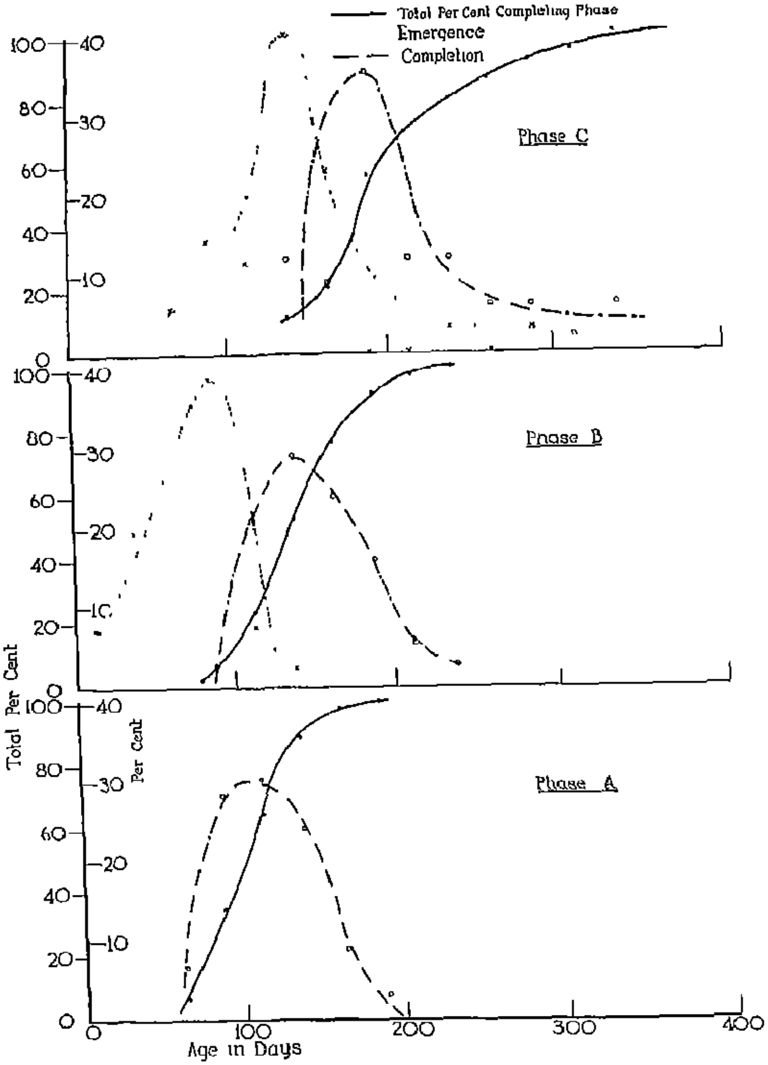


FIGURE 5

THE AGE DISTRIBUTION OF EACH PHASE AS MANIFESTED BY TWO UNRELATED GIRLS curve for Phase *H* would show a decline toward the base line as integrated creeping, or Phase *I*, develops Because these curves represent group data, including the fastest and slowest growing child, no curve actually shows 100 per cent for any phase. However, the general trend of the curves for the group data are essentially the same as the individual curves which were obtained by daily observations on four different children, and which are shown in Figures 4 and 5 Figure 4 represents individual curves showing the development of identical twin boys, the curves in Figure 5 represent those of two unrelated girls. From these four individual curves it is seen that the general trend of development in this activity is of the same order though the peaks for each phase for the four children fall at different times on the age axis Each point on these individual curves represents a percentage of plus ratings as obtained for each phase over a 20-day interval during which time approximately 14 observations were made.

In any group of infants the age variability as to the onset and completion of any one phase of development in an activity is considerable The variability is so wide, in fact, that some infants may have completed a phase by the time others have begun it. By selecting a 25-day interval and computing the percentage of children in whom the emergence of a particular phase occurred during that interval and the percentage of children for each interval in whom the completion of a particular phase was indicated, it was possible to determine the chronological period during which the greatest number of infants manifested a change in phase of development The age range and the modal distribution for both the emergence and completion of each phase are shown in the curves of Figures 6, 7, and 8 These curves show not only the peaks representing the modal age when the greatest number of children manifested the emergence or the completion of a particular phase, but in addition the ogive curve shows the total percentage of infants who had completed a particular phase at any given chronological age. When all of the children have completed a particular phase of development in creeping this type of curve reaches 100 per cent, and the slope of the curve is an indication of the homogeneity of the group with respect to the chronological age at which a particular phase was achieved The variability of the group of infants is also shown in tabular form (Table 1).



FIGURES 6-8

THE CURVES IN DOTTED LINES SHOW THE AGE DISTRIBUTION OF THE 82 INFANTS AT THE FIRST MANIFESTATION OF EACH PHASE, DOT-DASH CURVES SHOW THE AGE DISTRIBUTION OF THE GROUP AS TO THE COMPLETION OF EACH PHASE, AND THE SOLID LINE OGIVE CURVES INDICATE THE TOTAL PERCENTAGE OF INFANTS WHO HAD COMPLETED THE PHASE AT ANY GIVEN AGE

The dotted ogive curve of Phase *I* refers to the emergence rather than the completion of that phase.

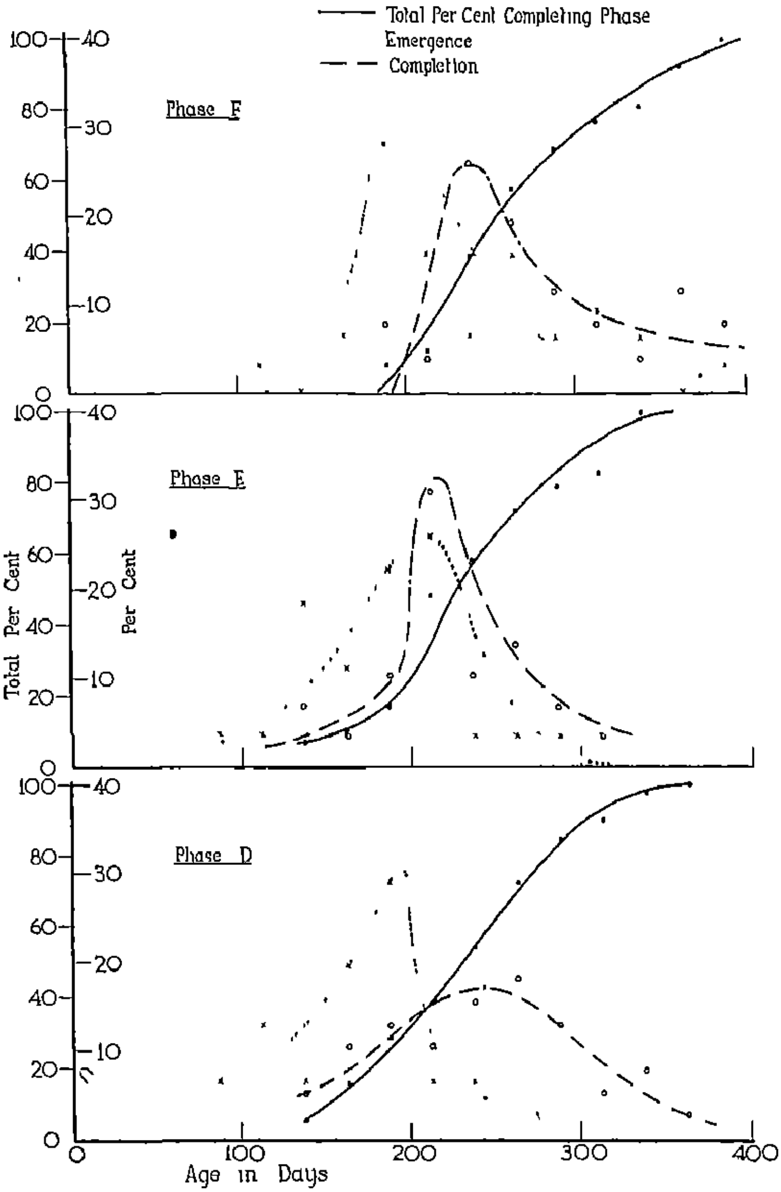

Total Per Cent Completing Phase
Emergence
Completion
Phase F
Phase E
Phase D
Total Per Cent
Per Cent
100
80
60
40
20
0
40
30
20
10
0
100
200
300
400
Age in Days

FIGURE 7

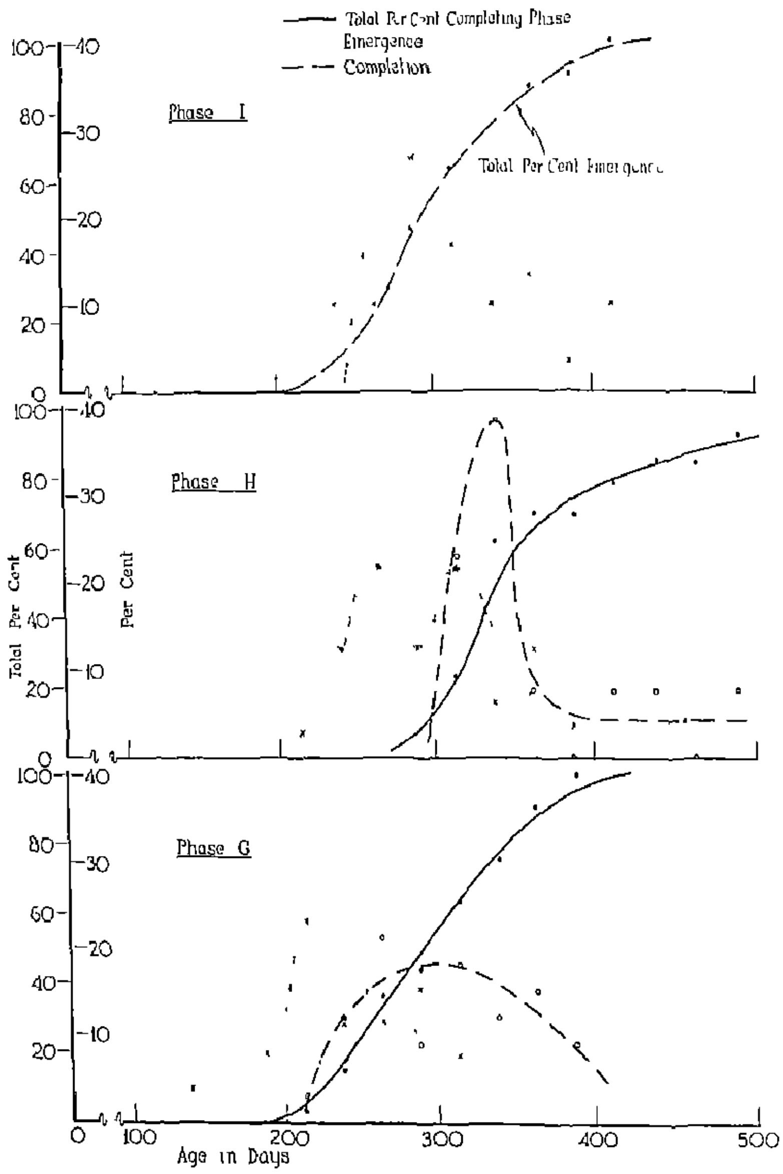

Total Per Cent Completing Phase
Emergence
Completion
Phase I
Total Per Cent Emergence
Phase H
Phase G
Total Per Cent
Per Cent
100
80
60
40
20
0
40
30
20
10
100
200
300
400
500
Age in Days

FIGURE 8

TABLE 1

Distribution of 82 Infants as to Their Manifestation of Nine Phases in the Development of Prone Progression

Phase	Emergence Age range in days	Emergence Mode	Completion Age range in days	Completion Mode
A	———	—	55-195	105
B	5-150	90	75-245	140
C	55-295	140	125-345	190
D	75-275	195	125-405	245
E	65-300	215	125-405	220
F	115-405	195	180-395	240
G	135-325	215	205-395	300
H	185-430	290	275-665	340
I	225-480	290	———	—

When dealing with group data the criteria set up for rating on a plus-minus basis somewhat distort the modal values, especially for Phases *D*, *E*, and *H*. It will be recalled that if an infant actually made progression but used only his upper extremities in doing so, he received a plus rating for both Phases *D* and *G*. This method of rating is useful in dealing with an individual record, for it is possible thereby to know the actual pattern of progression employed by the baby, but at the same time it will shift the modal age toward a later period on the age axis when group data are compiled. Rating the older children, i.e., those who had achieved erect locomotion on the creeping behavior in a similar manner altered the modal distribution for Phase *H*, since these ambulatory infants creep in a less well coordinated pattern than do the babies who are dependent upon prone progression as a means of locomotion. The bi-modal distribution for the appearance of Phase *H* is attributed to the fact that the abdominal creepers finally raise their bodies above the surface and creep in a palm-knee, tri-pedal, or quadrupedal fashion. The abdominal creepers plus the late creepers were sufficient to bring out a bi-modal distribution in the manifestation of this particular phase.

When the modes for the appearance of each phase are plotted against chronological age the data fall along a straight line showing that a phase change occurs in about 30 days and that the period from 100 to 300 days is the time during which new phases in the development of this activity are being manifested. When the completion of each phase, as expressed by the modal distribution, is plotted

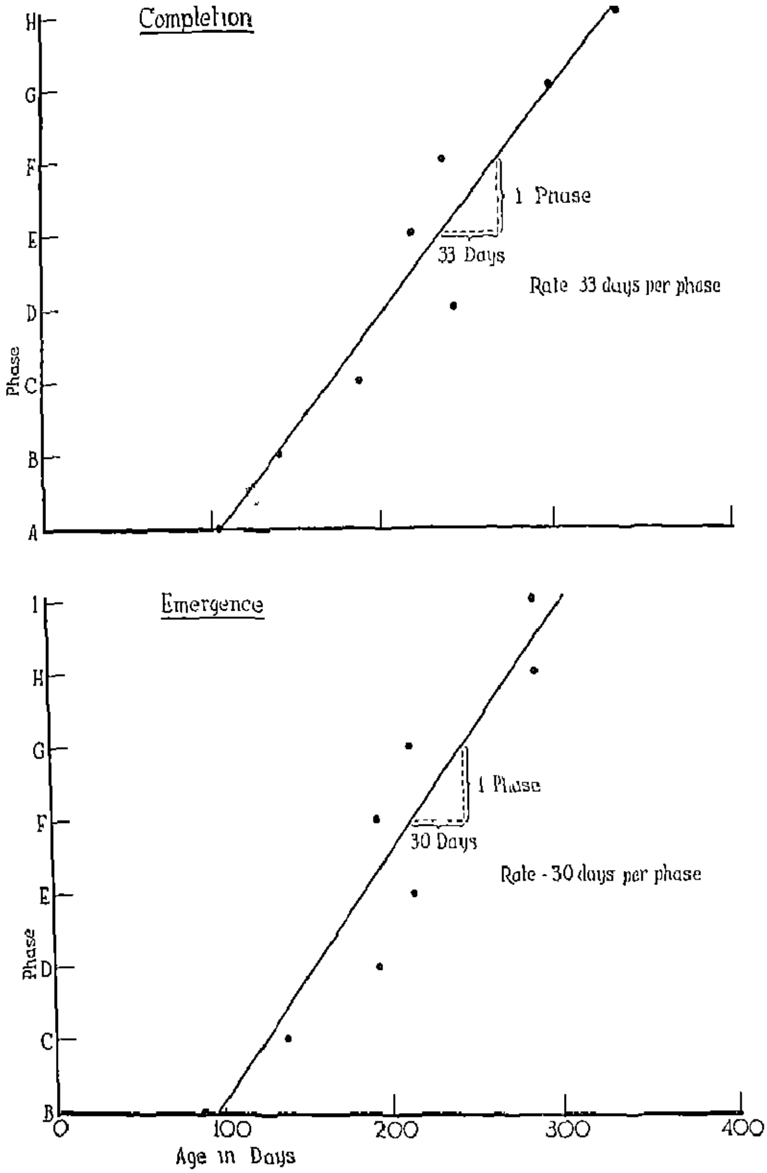


FIGURE 9

MODAL AGE OF THE GROUP OF 82 INFANTS AS TO THE (*a*) EMERGENCE AND (*b*) COMPLETION OF EACH PHASE PLOTTED AGAINST CHRONOLOGICAL AGE

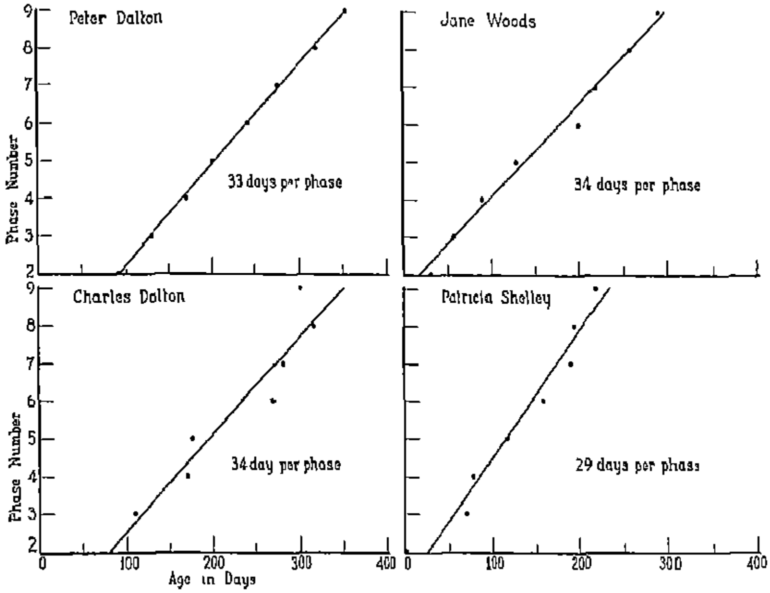


FIGURE 10

The First Appearance of Each Phase as Manifested by the Four Individual Infants (P D, C D, J W, and P S) Plotted against Chronological Age

against chronological age, again the data are distributed along a straight line, and the period of change occurs roughly within an age range from 100 to 340 days at a rate of approximately 33 days for each phase The distribution of these modal points, showing the age when the largest number of infants manifested the (*a*) emergence or (*b*) completion of each phase, is represented in Figure 9. When the order of appearance for each phase as manifested by the four infants on whom longitudinal studies were made is plotted against chronological age the data also fall along a straight line Individual variability is indicated on the age axis as to the time of inception of the various phases, as illustrated in Curves *a, b, c,* and *d* of Figure 10 These observations suggest that despite the age of the individual child at the inception of any phase of the activity the development of prone progression appears to unfold with regularity and order The curves also indicate that the phases as selected have meaning with respect to the order in which development of this activity takes place

Since the original ratings of the data were subjective and to a large extent dependent upon the experience and observational acuity of the rater, it seemed advisable to determine whether less experienced observers, after given instructions as to the method of rating, would show agreement in rating different phases of the activity. A series of motion picture films showing 31 different records of infants in various phases of prone progression were shown to (*a*) 13 members of the staff of the Normal Child Development Study and (*b*) 42 members of a summer school class in Child Psychology at Teachers College.[3] With the writer's ratings of the same recordings as a reference base it can be seen from the accompanying curves (Figure 11) that the staff of the Normal Child Development Study were in agreement in 84.4 per cent of the observations, and the Teachers College class concurred in 75.5 per cent of the ratings made. Of the instances wherein the ratings of these two groups deviated from the reference rating the deviations were seldom more than one or two phases, as can be seen from the curves of Figure

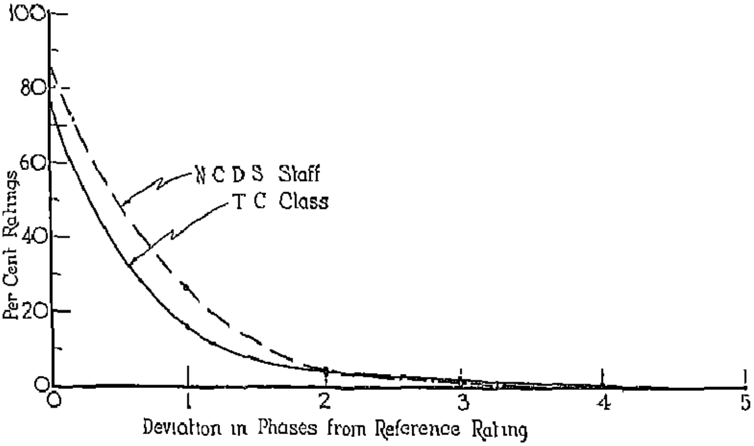


FIGURE 11
PER CENT DEVIATIONS FROM A REFERENCE RATING MADE BY TWO GROUPS OF RATERS, WHEN JUDGING MOTION PICTURES OF INFANTS SHOWING DIFFERENT PHASES OF PRONE PROGRESSION

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[3] Appreciation is expressed to Mr. J. L. Hymes, Jr., and members of his class for their cooperation in making these ratings.

11. Furthermore, the ratings are relatively better than their numerical values indicate because the reference ratings are considered to be 100 per cent, whereas in fact no one observer would make two or more series of ratings in perfect accord

From the columns of Figure 12 it can be seen that the greatest number of deviations in the ratings of the two groups were made in judging Phases *C, D, E,* and *G.* These phases occur when the behavior activity is in a more fluctuating state and the dominance of one pattern over another is more difficult to appraise As the activity stabilizes into a definite pattern it is relatively easier to formulate judgments as to the particular category into which it would best fit It is clear from these ratings that with only brief instruction less experienced observers can with considerable compe-

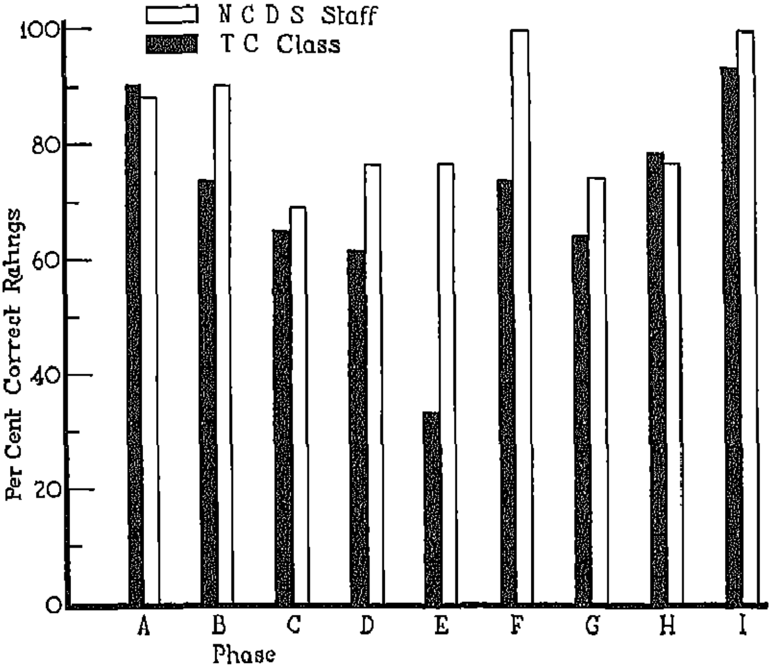

FIGURE 12

Column Showing the Correspondence Between Group Ratings and Reference Rating with Respect to Each of the Nine Phases of Prone Progression, as Analyzed tence judge and rate different phases of development in a behavior activity of this order

SUMMARY

As an outcome of a study of a group of 82 infants during the period of their development of prone progression descriptive criteria are presented outlining nine significant phases in the development of this activity from the time of birth until integrated creeping is established These successive changes in overt behavior reflect the advancing maturation of the central nervous system in a cephalo-caudal direction as the controlling influence shifts from nuclear to cortical centers. While actual determinations of neural structures are not available beyond the newborn phase, the interpretative rationale may serve a useful purpose in the correlation of development in overt behavior with changes in neural structures when additional direct evidence as to the post-natal maturation of the human nervous system is obtainable

Once the outstanding changes in a growing phenomenon have been adequately classified it is possible to apply some symbolic system to the data which render it more easy to manipulate intellectually and mathematically In this study plus-or-minus values were assigned to each phase of the activity at successive chronological ages. From these values it was possible to ascertain the percentage of occurrence of each phase during any age interval in a group of infants The general trend of development as revealed in the study of this group of infants is substantiated by a more intensive study of four individual infants on whom daily observations were made during their development of prone progression. The orderly arrangement in which development in behavior of this activity proceeds is further indicated when the emergence of each phase is plotted against chronological age As shown both by the group and the individual curves the amount of time consumed in the development of each phase is approximately 30 to 35 days. That these developmental changes in the advancement of a neuro-motor behavior are tangible differences which can be recognized by comparatively inexperienced observers, after brief instruction, is indicated by the encouraging percentage of agreement among the ratings of two groups of observers when they were shown motion pictures of infants in different phases of prone progression. One merit of the phase criteria as set forth in this study is that they can be used to reduce observations on prone progression to a symbolic form despite the individual differences in pattern which may be manifested by various infants. On the other hand the method of rating does not obscure the individuality or idiosyncratic pattern when longitudinal observations are made. While the usefulness of breaking up a growing behavior activity into sequential phases for the purpose of study is recognized it should at the same time be emphasized that no sharp lines of demarcation between phases are to be expected, for development proceeds steadily. These symbolic ratings are made merely as representing the dominance of one configuration over another. Developmental changes in overt behavior reflect the order in which neural centers governing the activity mature, and an understanding of the maturational process is appreciably advanced by recognition of the identifying qualities of each phase.

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The Journal of Genetic Psychology, 1941, 58, 113-129

FORM ABSTRACTION BY CHILDREN*[1]

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In a previous study Crudden (1) found that, as measured by the mean number of errors made in abstracting, it is more difficult to abstract an asymmetrical simple closed figure embedded in a more complicated figure than a similarly embedded, similarly constructed symmetrical figure embedded in a similar more complicated figure The following study is an analysis of the data obtained in the previous work in an attempt to learn something of the abstraction process in children other than as it is related directly to the problem of symmetry and asymmetry.

A. APPARATUS AND METHOD

The method, similar to that previously employed by Russel (6), involves little verbal direction. Two figures are simultaneously presented to the child on a large vertical screen One of these figures, if pushed slightly, gives an auditory reward, the other does not The child's task is to discover which is the correct figure to be pushed

The apparatus[2] consists essentially of a large gray pressed wood screen 70 x 70 cm in which two holes 3 x 3 inches are cut These holes are located halfway between the top and bottom of the screen and are 20 cm apart from center to center The screen is mounted on a small table at such a height that the holes are about level with *S*'s eyes

Card holders, mounted behind the holes, hold 3 x 3 inch white cardboard cards on which figures have been drawn in black india ink. The holders are so designed that they move away from *S* in response to slight pressure, which motion causes contact with dual adjustable electric switches, closes the circuit, and sounds an auditory

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*Received in the Editorial Office on October 27, 1939

[1] From the psychological laboratories of the University of Michigan

[2] A detailed description of the apparatus and reproductions of the figures used in this study will be found in Crudden (1, pp 11-19)

reward These rewards consist of the following, different ones usually being used at different sittings: a door bell, a single note gong chime, a small motor driven siren, an electric bicycle bell, a two tone bell, and motor driven devices sounding like a cat and a donkey. A conveniently located rheostat allows *E* to control the intensity of the reward sound A two-way switch, also controlled by *E*, allows the positive figure to sound regardless of which side it is on This switch is located under the table at the back of the apparatus No *S* was aware of its existence.

A small sliding metal screen, mounted between the card holders and the large gray screen, allows the cards to be simultaneously exposed or hidden at will.

The child was first trained always to select one of a pair of simple figures presented to him in the card holders of the apparatus *S* indicated his choice by pushing the selected figure which, if correct, sounded the auditory reward. Discrimination by size alone was discouraged by altering the relative size of the two simple figures during the learning period This training continued until *S* had at least five successive correct responses involving various combinations of size *S* was then told that *E* was going to try to "hide" these "pictures" from *S* by drawing lines around them, and *S*'s task was still to try to find the "picture" that rang the bell, i e, the simple figure to which *S* was trained to react positively The first pair of the test figures in which the simple figures were embedded was then given, then the second, and so on until eight different pairs were shown, each pair being presented only once, in chance order in regard to which side was positive If during the course of this test series there seemed to be some doubt as to whether *S* remembered which was the positive figure of the learned pair he was shown them, and if necessary retrained on them in a manner similar to the first training. This was found necessary in only a few cases, and was limited mostly to the first series The doubtful test pairs were then rechecked at a later sitting

Record was made of the response, whether correct or incorrect, of the time from presentation until the selected card was pushed, and of *S*'s ability to find any or both of the simple learned figures in the test pair A correct response was one where *S* pressed the positive figure and was able to show one or both of the learned figures in the test pair, or else was able to give three successive correct responses to the same test pair at different sittings.

No limit was set on the amount of time *S* could take in attempting to abstract. He was allowed to examine the test figures until the learned figures were found or until he became discouraged and resorted to guess

Any comments of *S* were noted Comments were encouraged, but care was taken not to ask any leading questions. *S* was usually asked, when he responded correctly, how he knew that the chosen one was correct, and to show where the simple learned figures were in the complicated test ones Often, to insure that he had actually found the simple learned figures, he was asked to trace them with his finger. He was also frequently asked which learned figure he had found first—the positive or the negative.

The simple figures-to-be-abstracted, or learned figures, which hereafter will be denoted as the *L* figures, are all designed so that the major distinction between the members of any pair is that one *figure has a prominent point and the other has a flat place* (*no* point) where the point is located on the former.

The *L* figures of the first series (Series *M*) consist of a pentagon and a hexagon, of the second series (Series *N*) a rectangle and a triangle, both of which are composed of curved sides Series *N* is the only pair of *L* figures constructed of curved lines, all other *L* figures having straight lines The *L* figures of the third series (Series *R*) are two inverted triangles, one of which is truncated. Both of these figures have a horizontal line within them connecting the opposite sides. Series *R* is the only series having *L* figures with internal structure All other *L* figures are simple "contour" figures The *L* figures of the fourth series (Series *S*) are an octagon and a hexagon The hexagons of Series *M* and Series *S* are similar only in the number of sides they possess In shape they are very different

The test figures, or figures from which the simple *L* figures are to be abstracted, which hereafter will be denoted as the *T* figures, are basically extensions of the sides of the *L* figures In the more complicated *T* figures other lines are added to these extensions In no instance did any of these additional lines making up the *T* figures pass through the *L* figures such as is found in Gottschaldt's figures (2) Thus the contour of the *L* figure remained as originally learned. In all, eight different pairs of L figures are used, half of which are asymmetrical. Each pair of L figures is embedded in eight pairs of T figures One pair of L figures and their accompanying eight pairs of T figures is called a "series" Thus there are four symmetrical series (designated as *M, N, R,* and *S* symmetrical), and four corresponding asymmetrical series (designated as *M, N, R,* and *S* asymmetrical). Approximately one-half of the *S*'s were trained to react positively to the pointed L figure of each pair and the remaining *S*'s to the non-pointed L figure To control any transfer of training effects the *S*'s were further divided in regard to the order of presentation of the symmetrical and asymmetrical parts of any one series, into two groups Group 1 was first presented with Series *M* and *N* symmetrical followed by Series *M, N, R,* and *S* asymmetrical, and then with *R* and S symmetrical in the order named. Group 2 was first presented with Series *M* and *N* asymmetrical followed by Series *M, N, R,* and *S* symmetrical, and then with *R* and *S* asymmetrical in the order named At least one week elapsed between the presentation of any one series and the succeeding series

A total number of 65 subjects ranging from 65 to 78 months of age was used, which was reduced to 59 during the course of experimentation. Group 1 was originally composed of 30 subjects, with the average chronological age of 71.8 months, and a mean *IQ* of 104 This group was later reduced to 28 subjects Group 2 was originally composed of 35 subjects, with the average age of 71.9 months, and a mean *IQ* of 106 This group was later reduced to 31 subjects In all, 30 boys and 35 girls took part in the study All were from the kindergartens and first grades of the Ann Arbor, Michigan, Public Schools[3]

A total of 1992 judgments was made in the symmetrical series and an equal number in the asymmetrical series The following results are therefore based on 3984 judgments made by 65 children

B RESULTS

1. *Comparison of the Poorer Abstracters with the Better Abstracters in Abstracting the Symmetrical and Asymmetrical Series*

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[3] The author is indebted to Miss Edith M Bader, Supervisor of the Ann Arbor Elementary Public Schools, and to the principals and teachers concerned for furnishing the pupils used in this study

As already shown by Crudden (1, pp 19-26), when measured by the mean number of errors made by all *S*'s in abstracting the simple *L* figures from the *T* figures the asymmetrical series are more difficult to abstract than their corresponding symmetrical series.

Examination of the *S*'s individual records indicates that some *S*'s appeared to be little affected by asymmetry, others very much so To examine further this phase of our results each group of *S*'s (Groups 1 and 2) was divided into two sub-groups. Group 1*A* was composed of all *S*'s in Group 1 who made *less* than the mean number of errors for Group 1 in the asymmetrical series taken as a whole, and Group 1*B* all the *S*'s who made *more* than the mean number of errors in the asymmetrical series taken as a whole Group 2 was similarly divided into Groups 2*A* and 2*B* Only those *S*'s who completed the experiment and whose *IQ* was available were used for this comparison.

Table 1 gives the results in terms of the mean number of errors

TABLE 1

COMPARISON OF MEAN NUMBER OF ERRORS OF GROUPS *A* AND *B*

	Group number							
	1	2	1A	2A	1A&2A	1B	2B	1B&2B
Number *S*'s with *IQ* available	26	30	13	19	32	13	11	24
Mean number symmetrical errors	3.96	2.50	2.61	1.74	2.17	5.61	3.82	4.72
Mean number asymmetrical errors	5.96	4.40	2.23	2.31	2.27	10.61	8.00	9.30

for these groups Examination of this table shows (*a*) Both Groups 1 and 2, taken as a whole, show a decided increase in the mean number of errors in the asymmetrical series as compared with the symmetrical (*b*) Groups 1*A* and 2*A* show little difference in the mean number of errors made in the symmetrical and asymmetrical series (*c*) Groups 1*B* and 2*B*, both show a decided increase in the average number of errors made in the asymmetrical as compared with the symmetrical, Group 2*B* making more than twice the number of errors as in the symmetrical (*d*) Although the symmetrical series is much easier than the asymmetrical for the *B* Groups, these groups make approximately as many errors in the symmetrical series alone as the *A* Groups do in both the symmetrical and asymmetrical series combined

We may therefore conclude, as measured by the failures to abstract, that those *S*'s who have difficulty in abstracting the symmetrical series have much greater difficulty in abstracting the asymmetrical series, while those *S*'s who have relatively little difficulty in abstracting the symmetrical series likewise have relatively little difficulty in abstracting the asymmetrical series. This would indicate that genetic individual differences play as paramount a rôle in any form of abstraction as do the configurational aspects of the stimulus

Examination of the time in seconds taken by Groups *A* and *B* to abstract yields significant results. Table 2 gives a comparison of the average time taken to abstract all the *T* figures where a correct response is made. Examination of this table shows. (*a*) Group *A* (1*A* and 2*A* combined), as measured by the mean number of seconds, took a longer time correctly to abstract the asymmetrical figures than the symmetrical. Although the standard deviations are large this difference is reliable (*b*) Group *B* (1*B* and 2*B* combined), as measured by the mean time in seconds, took approximately the same amount of time to abstract the symmetrical as the asymmetrical figures.

TABLE 2

COMPARISON OF THE TIME IN SECONDS FOR A CORRECT RESPONSE BY GROUPS *A* AND *B*

	No correct responses	Mean time (seconds)	*SD*	*PE* Mean	$\frac{D}{PE\ diff}$
Group A					
Symmetrical	701	4.22	4 11	105	6 48
Asymmetrical	680	5 25	4 61	119	
Group B					
Symmetrical	479	3 94	3 07	094	30
Asymmetrical	381	3 90	2 64	091	

The better abstracters show little difference in the number of errors they make in the symmetrical and asymmetrical series, but they take more time to abstract the asymmetrical We may therefore conclude that the asymmetrical series is more difficult for all our *S*'s, but the superior group does not become so easily discouraged with the increased difficulty, and hence reports more correct responses

If this conclusion is correct it is to be expected that there will be relatively little difference in the times taken by the superior *A* and inferior *B* group to give a correct response to the easier *T* figures as compared to the more difficult ones It would be likewise expected *that the average time taken by the* superior group to give an *incorrect* response to a difficult *T* figure would be much longer than by the inferior group since the former would persist much longer than the latter before giving up and resorting to a guess

Table 3 gives a comparison of the mean time the *A* and *B* groups

TABLE 3

COMPARISON OF THE AVERAGE TIME IN SECONDS FOR A CORRECT RESPONSE BY THE *A* AND *B* GROUPS TO THE THREE EASIEST AND TWO MOST DIFFICULT *T* FIGURES IN EACH SERIES

(Average of all series)

Series	Three easiest *T* figures Symmetrical	 Asymmetrical	Two most difficult Symmetrical	 Asymmetrical
Groups 1A & 2A	2.75	3.02	8.20	7.83
Groups 1B & 2B	2.87	3.29	7.22	5.40
Ratio A/B	.96–1	.92–1	1.13–1	1.45–1

took to give a correct response to the three easiest and two most difficult *T* figures of each series as measured by the total number of errors made with each *T* figure. Examination of this table shows that in the three easiest *T* figures the *A* groups took slightly less time than the *B* groups, while in the two most difficult *T* figures the *A* groups took *more* time than the *B* groups This is particularly true in the asymmetrical (7.83 as compared to 5.40).

Examination of the mean time in seconds taken for the two most difficult *T* figures in each series where an *incorrect* response was made shows that Groups 1*B* and 2*B* spent an average of 7.27 seconds on the symmetrical and 7.07 seconds on the asymmetrical series before resorting to a guess. The superior Groups 1*A* and 2*A* spent 10.73 seconds (47 per cent more than the *B* groups) on the symmetrical and 11.13 seconds (57 per cent more than the *B* groups) on the asymmetrical

We may therefore conclude that one of the important differences between the good abstracter and the poor abstracter is perseverance when confronted with a difficult abstraction problem This quality tends to level the differences in difficulty between the symmetrical and asymmetrical series when measured by the number of failures to abstract, but becomes evident when consideration is given to the time taken by the superior groups to abstract these series

2 *Analysis of the L Figures by the S's*

During the process of learning the *L* figures of any particular series many of the *S*'s indicated by their verbal reports that they analyzed these figures by certain likenesses and differences, these same likenesses and differences being later utilized when abstracting the *L* figures from the *T* figures. As was previously discussed by Crudden (1, pp 30-37) these likenesses and differences were made on the basis of (*a*) shape of the *L* figures as a whole, (*b*) associations with familiar objects, and (*c*) certain characteristic parts of the *L* figures Of the last named the following were reported· (*a*) one figure is pointed, the other is not or is "square," (*b*) differences in the number of lines composing the sides of the *L* figures, (*c*) differences in direction of curvature of the *L* figures of *N* series, (*d*) differences in the size of the *L* figures, (*e*) differences in size of certain corresponding angles of the *L* figures, (*f*) the number of horizontal lines in the two *L* figures of Series *R*, (*g*) the number of squares that compose each *L* figure in Series *R*, (*h*) relative length of the longest side of the two *L* figures, and (*i*) relative length of all the lines composing the two *L* figures

This analysis into likenesses and differences was not limited to the learning period of the *L* figures, but continued throughout the presentation of the *T* figures One *S* reported using as a cue a part *L*, part *T* figure construction that occurred several successive times in *R* asymmetrical series. This combination made a sort of *X* which in one figure was straight and in the other had a bent leg *S* reported that one "cross" was broken, the other not Four *S*'s reported using certain accidental cues in the *T* figure construction of *S* asymmetrical series in order to differentiate and abstract the *L* figures One *L* figure, they reported, "had lots of dots around it" and the other did not.

The *S*'s did not necessarily use one method of distinguishing the *L* figures to the exclusion of others, sometimes employing two or more methods in the same series The danger of interpreting the remarks of children of this age is fully realized Within these limitations, however, it appeared that the same S might use the figures-as-a-whole to distinguish the pair of L figures of one series and certain characteristic parts of the L figures of another series Few S's appeared to use the figure-as-a-whole or part methods exclusively throughout the experiment. Likewise, both types are to be found in the good and poor abstraction groups, so that method of distinguishing the L figure does not seem to be related to abstractive ability

3. *Methods of Abstraction*

Three different methods of examining the pair of T figures when presented to the child were distinguishable. (*a*) A direct method in which the child went directly to the correct card without looking at the other member of the pair. This method was usually and most frequently employed with the simpler T figures (*b*) A rapid back and forth comparison of the pair which usually continued until a choice was made This method was employed particularly with the more difficult T figures (*c*) The studying of one member of the pair for a period of time and then the studying of the other member, after which a choice was made This method was also employed with the more difficult T figures There were a number of varieties of this method, ranging from S studying one member of the pair carefully and merely glancing at the other before a decision was made, to a careful examination of one card for a period of 10 seconds or longer, followed by examination of the other card for a similar length of time Often the child would inspect the card so closely that his nose would almost touch it, and often there would be verbal accompaniments Sometimes the child would return to the first card again and examine the pair, one by one, before making a final choice Thus, Methods 2 and 3 overlap to some extent.

These methods are similar to those found by Russel (6) in children and Grunbaum (3) in adults, although the latter found a larger number of methods The present writer has also noticed similar methods used by rats in a somewhat comparable situation

4. *Complete and Partial Abstraction*

By complete abstraction is meant the successful abstraction of both the positive and negative L figures When both L figures were found the positive figure appeared to be most frequently found first, although discovery of the negative figure first was nearly as often reported. In some *T* figures there was a tendency to find one *L* figure first regardless of whether it was positive or negative It would appear in such cases that the *L* figure in the preferred member of the *T* figure pair was relatively less embedded than the *L* figure in the other member of the pair, and preference was because of this lesser degree of embeddedness Sometimes the same *S* in the same series would find the positive figure first in one pair of *T* figures and the negative figure first in another pair

By partial abstraction is meant that the *S* was unable to abstract both of the pair of *L* figures This occurred most frequently in the more difficult *T* figures. Abstraction might be limited to either the positive or negative figure There appeared to be a tendency, however, to abstract the positive *L* figure more readily than the negative. This was true regardless of which of the pair of *L* figures was positive and which negative. As in complete abstraction, in some *T* figures there is a tendency to abstract one particular figure regardless of whether it is positive or negative. Likewise, the same *S* in the same series would abstract the positive figure only in one *T* figure and the negative only in another. When only the negative figure was abstracted the *S* always gave a correct response The usual remark of the *S* was, "*I found the wrong picture so I knew the other one rings the bell.*"

Abstraction might also be limited to only certain characteristic parts of the *L* figures without successful later abstraction of the remaining parts of the figure Two instances in *R* symmetrical series and one in *M* symmetrical series were reported where only the point of the pointed *L* figure was successfully abstracted In *S* symmetrical series the eighth pair of *T* figures each contain a smaller figure, one side of which resembles the embedded pointed *L* figure and the other side the embedded non-pointed *L* figure. Three *S*'s here abstracted the pointed half as the pointed *L* figure, apparently not noticing the remaining half of the figure They exhibited no confusion until *E* showed them that the remainder of the figure did not correspond with the *L* figure they designated it to be

5 *Relative Number of Errors in Abstraction when the Pointed L Figure is Positive as Compared to where the Non-Pointed L Figure is Positive*

Comparison of the mean number of errors made in abstraction by the *S*'s who were trained to give a positive reaction to the pointed member of the *L* pair of figures in each series with *S*'s trained to give a positive reaction to the non-pointed *L* figure shows the following In Group 1 10 *S*'s[4] trained to give a positive reaction to the pointed *L* figure in each series have a mean of 1.99 errors, *SD* 1.13, while *nine S's trained to give a positive reaction to the non-pointed figure* have a mean of 1.43 errors, *SD* .54 For Group 2 17 *S*'s trained to give a positive reaction to the pointed *L* figure have a mean of 1.96 errors, *SD* 1.16, while 13 *S*'s trained to give a positive reaction to the non-pointed *L* figure have a mean of 1.46 errors, *SD* 1.17. The $\frac{D}{P.E.\ diff.}$ for Group 1 is .58, for Group 2 is .15. Thus there is a slight tendency for *S*'s trained to give a positive reaction to the pointed *L* figure to make more errors than those trained to react similarly to the non-pointed *L* figure, but this difference is not reliable Since our *S*'s introspections show that the negative *L* figure has almost if not an equal influence as the positive *L* figure in determining *S*'s reaction it would hardly be expected that a significant difference would be found. What differences exist may be the result of differences in the abstractive ability of the *S*'s themselves who were trained to give a positive reaction to one *L* figure as compared to those trained with the other *L* figure, or it may be due to differences in degree of embeddedness of the pointed *L* figure as compared to the non-pointed one

6 *Direction*

That the method used in this experiment presents a more difficult task for abstraction than the method used by Heiss (5), where a single known *L* figure is presented embedded in a single complicated *T* figure, is evident from what might be termed *"Direction"* Many incidences are present in our results in which the child, after making an erroneous choice and having pushed the wrong card, was nevertheless able to point out the simple *L* figure or figures in the pair Similarly, children who sometimes made a correct choice showed that they had merely guessed correctly, but after knowing which of the pair was the correct one they were able to find either one or both of the *L* figures Children under these circumstances were sometimes able to find (*a*) the positive figure only, (*b*) the negative figure only, (*c*) both positive and negative figures. Knowledge of which of the pair of *T* figures contained the positive and which the negative *L* figure established a direction towards one particular *T* figure frequently resulting in successful abstraction.

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[4] The remaining *S*'s were trained to give a positive reaction to the pointed *L* figure in some of the series and the non-pointed *L* figure in the remaining series This technique was found to tend to create some confusion in some *S*'s and hence was abandoned early in the study

7. *Correction of Abstraction Errors*

Immediately after *S* made an error in attempting to abstract the *L* figures from a pair of *T* figures he was frequently able correctly to abstract these figures (direction). When *S* was unable to do so *E* would show him where the embedded positive and negative *L* figures were in the particular pair of *T* figures in which *S* made his error The following week, after the series scheduled for that week were concluded, the *L* figures employed in the series of the previous week were presented to *S* and, if necessary, he was retrained on them When *S* was able to make five successive correct responses to these previously learned *L* figures he was presented with all those pairs of *T* figures of the series of the previous week in which he had made an error.

Examination of the results obtained by this procedure shows that of a total of 412 retests given to all *S*'s in all series of *T* figures in which, on first presentation, an error was made, 203 or 49 14 per cent were corrected in the retest We may therefore conclude that when an *S* fails in an abstraction task and he is shown the correct solution immediately after that failure, he will show a decided improvement when presented with the same abstraction task at a later date

8. *Comparison of Chronological Age, Sex, and IQ with the Number of Failures to Abstract in all Series*

a Chronological age Comparison of those *S*'s ranging from 65 to 71 months inclusive with those ranging from 72 to 78 months shows that in Group 1 the younger *S*'s made an average of 13.43

errors and the older *S*'s an average of 16.86 errors. The younger *S*'s in Group 2, however, made more errors than the older (younger *S*'s 15.78, older 10.47). Since the older *S*'s of Group 1 were largely drawn from a class who were somewhat retarded in their school work it is possible that the age comparison of Group 1 does not represent a true comparison. It is also possible that our age range is too narrow to show much difference in abstractive ability. Preliminary work with younger *S*'s (40 months) indicated, as would be expected, that chronological age is related to abstraction ability, the younger *S*'s being unable to perform as difficult abstraction tasks as the older *S*'s.

b. Sex. Table 4 shows a comparison of the number of errors made by each sex. Examination of this table shows that in both groups the girls are superior to the boys. Although this difference is not completely reliable as measured by $\frac{D}{PE\ diff.}$ the results of both groups are in the same direction. These sex differences are in direct opposition to the results of Van den Torren (8), Habrich (4), and the Schobers (7), who found girls to be inferior to boys. In Group 2 this may be due to difference in intelligence, since the girls showed a mean *IQ* of 108.88 as compared to the boys' 103.64. In Group 1, however, the mean *IQ* was almost equal for both sexes (boys 104.73, girls 104.40). Probably the difference of results is due to a difference in methods in the above and the present studies.

TABLE 4

COMPARISON OF SEX AND TOTAL NUMBER OF ERRORS

	Group 1		Group 2	
	Boys	Girls	Boys	Girls
Number of *S*'s	12	16	14	17
Mean	18.17	12.81	15.85	10.76
SD	10.8	5.38	7.93	4.89
$\frac{D}{PE\ diff.}$	2.77		3.10	

c. IQ. Comparison of *IQ* and the number of correct responses made gives a correlation of + .47, *PE* .10 for Group 1 and + .29, *PE* .11, for Group 2.

C Conclusions

Our results throughout this study would seem to emphasize a considerable degree of variability and flexibility in the process employed by the *S*'s in abstracting the *L* figures. First it is found that in the learning process some *S*'s analyze the *L* figures into certain parts, others do not. Analysis of the *L* figures is made in a variety of ways by the different *S*'s On presentation of a pair of *T* figures *S*, in attempting to abstract, utilizes a method which varies both with the individual and the difficulty of the abstraction task. Again, successful abstraction may begin with either the positive or negative *L* figure. The whole *L* figure may, apparently, be abstracted simultaneously or some characteristic part or parts first abstracted, followed by the remainder of the figure Likewise, abstraction may be limited to only one figure or even to only certain characteristic parts of the positive and negative *L* figures without later successful abstraction of the remainder of the figures.

Furthermore, the cues used by the *S*'s in distinguishing the two *L* figures when they are embedded in the *T* figures do not only vary with different *S*'s but also with the same *S* in different pairs of *T* figures in the same series Thus on presentation of one pair of *T* figures *S* may make his selection on the basis of the embedded *L* figure-as-a-whole, in a second pair by the relative size of certain corresponding angles of the *L* figure, and in a third pair by the fact that one *L* figure has a prominent point and the other does not

It would appear from our results that each pair of *T* figures of a particular series represents a more or less separate problem in itself The manner in which the abstraction process will operate as well as the end result of that process is the resultant of a number of factors interacting at the moment a particular *T* figure pair is presented Some of these factors are primarily dependent on the *S* himself and some primarily on the stimulus. Likewise, some of these factors appear to be directly related to successful abstraction while others are present in the abstraction process but, as far as known, do not directly contribute to successful abstraction.

Factors found in the present study which appear to be directly related to successful abstraction are (*a*) degree to which the *L* figure is embedded;[5] (*b*) symmetry of the *L* figure, (*c*) perseverance on

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[5] For further discussion see Crudden (1)

the part of S when *confronted with an abstraction task*; (*d*) knowledge of which *T* figure contains the positive *L* figure; (*e*) previous knowledge of where the *L* figure is embedded in the *T* figure, (*f*) *IQ;* and (*g*) sex. Factors found in our study to be present in abstraction but which apparently are not directly related to successful abstraction are (*a*) analysis of the *L* figures; (*b*) method of examining the *T* figures; (*c*) which *L* figure is positive; and (*d*) chronological age within the range of the present study

D SUMMARY

Four series, each containing eight pairs of complicated figures in which a pair of simple closed symmetrical geometrical figures have been embedded, and four corresponding series, each containing eight *pairs of complicated figures in which a pair of corresponding* asymmetrical figures have been embedded, were presented to a total of 65 *S*'s. These *S*'s ranged from 65 to 78 months of age *S*'s specific task was to find the previously learned pairs of simple figures in each pair of complicated figures Practice and transfer of training were equated by dividing the *S*'s into two groups and varying the order in which the symmetrical and asymmetrical series was presented to these groups The results are examined with the specific *purpose of studying abstraction other than as it is particu*larly related to symmetry and asymmetry A number of factors in abstraction are demonstrated These may be classified as factors which are known to be directly related to successful abstraction and factors present but whose relation to successful abstraction is unknown.

1. Factors found in this study to be directly related to successful abstraction are:

a. Perseverance Comparison of the average time successfully to abstract the three easiest and two most difficult *T* figures in each series as measured by the average number of failures to abstract shows that the superior abstracters persist longer than the inferior abstracters when confronted with a difficult abstraction task Comparison of the average time taken on the two most difficult figures where an incorrect response was made verifies this statement.

b Direction The knowledge of which member of the pair of *complicated figures contained* the positive or negative simple figure often resulted in successful abstraction where, previously, no abstraction could be made.

c. Learning When an *S* who has failed in an abstraction task is shown the correct solution immediately after he fails he will show a decided improvement if presented with the same abstraction task at a later date.

d Sex Comparison of sex with the mean number of errors made in all series combined shows the girls to be superior to the boys in abstraction ability as studied by this particular experiment

e. IQ. There is a definite relation between *IQ* and abstraction ability, those having a higher *IQ* tending to be the better abstracters.

2 Factors present in the abstraction process but which show no direct relation to successful abstraction are

a Analysis of the simple figures Many *S*'s analyze the simple figures in a variety of ways, both while they are learning them and while they are abstracting them This analysis is utilized when the simple figures are abstracted from the complicated ones As far as could be discovered by the available data no relation between analytical ability and abstraction ability appears to exist

b. Methods of examining the complicated figures Three principal methods of examining the pair of complicated figures when presented to the child are distinguishable These methods vary both with the difficulty of the abstraction task and the individual

c Which simple figure is positive Comparison of the mean number of errors made by those *S*'s trained to give a positive reaction to the pointed simple figure with those trained to give a positive reaction to the non-pointed simple figure shows no significant difference. Since the *S*'s reports indicate the negative figure has almost, if not as much, influence in determining the *S*'s reaction, these findings are not contrary to expectations

d. Chronological age. Within the chronological age limits of the *S*'s used in the present study no difference in abstraction ability between the older and younger *S*'s could be demonstrated

3 A considerable degree of variability and flexibility of the abstraction process is evident Abstraction of the simple figures may begin with either the positive or the negative figure Likewise, it may be limited to the positive or negative figure alone or, in a few

cases, to only certain parts of the simple figures without later successful abstraction of the remainder of the figures

4 The manner in which the abstraction process will operate at any particular moment as well as the end result of that process appears to be the resultant of a variety of interacting factors Some of these factors appear to be primarily dependent on the *S* himself and some primarily on the stimulus

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The Journal of Genetic Psychology, 1941, 58, 131-138

A STUDY OF THE DRAWINGS OF MALADJUSTED AND ADJUSTED CHILDREN[*]

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A. INTRODUCTION

For many years some psychologists and psychiatrists have been of the opinion that the drawings of an individual may throw some light on the workings of the mind. The earlier investigations of DeFursac (3), Kurbitz (6), Reja (7), and Rouma (8), have shown evidence that abnormalities and the disintegration of mental function can be observed in the drawings made by the insane. While these studies were concerned primarily with insane adults, as early as 1908, Sully (9, p. 332) was of the opinion that the first crude drawings of the child are valuable in throwing light on the workings of the child's mind. He felt that study may show that the spontaneous efforts of the childish mind to draw objects may be a medium of expression of the whole of child nature, hardly less instructive than that of early speech.

Goodenough (4) has devised a method of objectively rating the drawings of children. The *Drawing of a Man Intelligence Test* was standardized primarily for judging mental development. Her study has shown that children's drawings are dependent primarily upon intellectual development. The Goodenough technic has proven of great value and the results give a reliable index of certain aspects of mental development. Goodenough (4, p. 50) reports coefficients of correlation ranging between .70 and .86 for drawing scores and the Stanford-Binet.

While the Goodenough *Drawing of a Man Test* was standardized as an intelligence test, Goodenough (4, p. 62) has pointed out that since spontaneous drawing is so closely related to the mental life of the individual, it may sometimes reveal maladjustment before it has manifested itself to any marked degree in everyday behavior. She observed certain qualitative differences in the drawings of some of the children, which she believed might be indicative of psycho-

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[*]Received in the Editorial Office on October 31, 1939.

pathic tendencies Her data, however, were very meager and did not warrant any definite claims that it was possible to diagnose psychopathic tendencies in children by means of drawings She suggested that further investigation be carried on

Berrien (1) studied the Goodenough drawings of 52 abnormal children who were inmates of a state hospital. His purpose was to evaluate statistically certain tentative generalizations made by Goodenough concerning the drawings of psychopathic children and also to discover diagnostic differences on an item-by-item analysis of the data. Berrien reports that diagnostic differences appeared on particular items of the drawing scale A reversal of sex characteristics appeared in the drawings of post-encephalitics, but the other groups of children with psychopathic personalities and borderline deficiency diagnosis were similar to those found in normal children in this respect Only a few of the drawings showed individual responses or evidence of a "verbalist type." Goodenough's hypothesis that combinations of mature and primitive drawing characteristics occur in cases characterized by great emotional instability was substantiated

Brill (2) studied the performance of adjusted and maladjusted mentally deficient boys on the Goodenough drawing scale He reports that a comparison of the per cent of adjusted and maladjusted earning credit on the various items revealed the fact that in all except eight items, the per cent differences were in favor of the adjusted group

The studies described above appear to indicate that the Goodenough drawing scale not only measures intellectual development, but tends to differentiate unstable children from those with normal personalities

B PROBLEM AND METHOD

The purpose of this study is to ascertain whether the objective items of the Goodenough drawing scale differentiate between intellectually normal children who differ significantly in regard to behavior adjustment and who can be considered as maladjusted and adjusted groups

The children whose drawings are reported in this study attended the regular public schools of New York City Their ages ranged from six to twelve years and the sexes were nearly equally divided All were given the Goodenough *Drawing of a Man Intelligence*

Test and were found to be of normal mental ability and comparably equated. Teachers' ratings on the Haggerty-Olson-Wickman *Behavior Rating Schedules* (5) were obtained for each child. The maladjusted and adjusted groups received significantly different scores on these behavior rating schedules.

The personal data of the adjusted and maladjusted groups are given in Table 1. The mean chronological age of the 409 boys and girls included in the adjusted group is 9.29 years, and the mean age of the 330 children in the maladjusted group is 9.49 years. The difference between the mean Goodenough scores received by the two groups is only .17 and indicates that both the adjusted and maladjusted groups are of comparable intelligence.

TABLE 1

A COMPARISON OF THE PERSONAL DATA OF THE ADJUSTED AND MALADJUSTED GROUPS

	Adjusted (N=409)		Maladjusted (N=330)				
	Mean	*SD*	Mean	*SD*	M_{diff}	SD_{diff}	Critical ratio
Age in years	9.29	1.76	9.49	1.67	.20	.13	1.54
Goodenough score	26.38	9.10	26.55	8.83	.17	.65	.26
H-O-W Schedule *A*	14.81	15.94	26.01	23.51	11.20	1.50	7.47
H-O-W Schedule *B*	70.06	16.65	76.38	21.56	6.32	1.43	4.42

The results obtained by the two groups on the Haggerty-Olson-Wickman *Behavior Rating Scales* indicate that both groups differ from each other in a significant manner. Schedule *A* of the *H-O-W* is a record of the incidence of behavior problems. The mean score received by the maladjusted is 11.20 points higher than that received by the adjusted children. This difference is large and indicates that the maladjusted children present more behavior problems than the adjusted. The difference between the two groups is reliable statistically, as is indicated by the large critical ratio of 7.47.[1] Schedule *B* of the *H-O-W* covers a wide variety of personal traits and characteristics, and gives a score which is indicative of problem tendencies. Again we find that the maladjusted group received higher scores which indicate the presence of more undesirable behavior traits than the adjusted group. The mean difference between the adjusted and maladjusted children is 6.32, and this is of reliable statistical significance, as is indicated by the critical ratio of 4.42

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[1] Throughout this study, a critical ratio ($D/\sigma diff$) of three or more is considered to be indicative of a significantly reliable difference between the two groups that are compared.

The personal data reveals that the adjusted and maladjusted children are comparably equated in age and intelligence. The maladjusted, however, receive higher and less desirable scores in regard to the incidence of behavior problems and behavior traits

C. Results

An analysis of the Goodenough drawings was made in terms of the per cent of success made by the adjusted and maladjusted groups on each item. The per cent differences that exist between the groups were then computed and the reliabilities of the differences determined in terms of critical ratios. There are 51 items in the Goodenough drawing scale. The results indicate that on 36 of these items, the adjusted and maladjusted children are equally successful. The per cent differences between the two groups are very small and statistically insignificant On the remaining 15 items, the differences between the success of the maladjusted and adjusted children are larger These differences are reliable and of statistical significance, as indicated by the critical ratios ranging from 3.00 to 9.09. The adjusted group is more successful on six of the items, while the maladjusted are more frequently successful on nine of the 15 items.

TABLE 2

Goodenough Items on Which the Adjusted and Maladjusted Groups Differ Reliably

Adjusted are more successful on	Maladjusted are more successful on
1 Item 9*b* Two articles of clothing non-transparent	1. Item 7*b* Nose present
2 Item 10*b* Correct number of fingers	2 Item 7*c* Mouth present.
3 Item 12*b* Arms in proportion	3 Item 7*e* Nostrils indicated
4 Item 12*c* Legs in proportion	4. Item 8*b* Hair detail, non-transparent.
5 Item 14*c* Motor coordination. Head outline.	5. Item 9*a* Clothing present
6 Item 14*d* Motor coordination. Trunk outline.	6. Item 9*c* Clothing entirely non-transparent
	7 Item 10*c* Finger detail correct Two dimensions
	8. Item 10*e* Hand shown
	9. Item 12*e* Arms and legs in two dimensions

These items are listed in Table 2 It is apparent that the number of items on which the adjusted differ from the maladjusted is not large. An inspection of these items shows, however, that the adjusted tend to be more successful in those items which involve motor coordination and correct proportions of the arms and legs to the trunk The maladjusted tend to include more detail in their drawings in regard to the parts of the body and clothing

Goodenough (4, p 63) is of the opinion that drawings characterized by a large amount of detail, but comparatively few ideas ("verbalist" type) are an indication of psychopathy. Comparatively few of the drawings of either the adjusted or maladjusted groups were of the "verbalist" type or of the "individual response" type—that is, drawings containing features which are inexplicable to anyone except the child himself Less than a dozen drawings containing these characteristics were found in each group In general, it is difficult to differentiate the adjusted from the maladjusted by their drawings. There was a great amount of overlapping between both groups on each item, and it is impossible to diagnose individual cases of maladjustment

Goodenough has suggested that the combinations of primitive and mature characteristics in a single drawing may be evidence of psychopathy because of uneven mental development The arrangement of items on the Goodenough scale does not progress evenly from the primitive to mature characteristics Berrien (1, p. 149) has selected and paired from Goodenough's original data 20 items which are similar in their incidence at various year intervals in normal children These items are approximately equal so far as being rated primitive or mature If Goodenough's hypothesis concerning indications of psychopathy are correct, normal well-adjusted children should pass any set of paired items with approximately equal frequency. Psychopathic children should exhibit a greater difference of success between any two paired items than normal children.

The drawings of the adjusted and maladjusted children of this study were analyzed in regard to their per cent of success on the items of similar maturity The per cent of success on one of the items in a pair was subtracted from the per cent of success on the other item, giving a difference These results are listed in Table 3 An analysis of the results shows that there is a slight tendency for

TABLE 3
THE PER CENT OF DIFFERENCE OF SUCCESS ON PAIRED ITEMS OF SIMILAR MATURITY

Items of similar maturity	Per cent difference Adjusted	Per cent difference Maladjusted	Difference between adj & maladj *
4*c* and 14*c*	15	24	— 9
6*a* and 17*a*	1	1	0
6*b* and 11*a*	23	17	6
9*c* and 14*f*	1	26	—25
11*c* and 14*d*	16	1	15
2 and 7*a*	2	1	1
7*b* and 7*c*	1	1	0
7*c* and 15*b*	72	82	—10
14*b* and 18*b*	11	6	5
16*c* and 17*b*	12	11	1
Total	154	170	

*A minus sign in this column indicates that the maladjusted group exhibits a greater difference of success between paired items of similar maturity than the adjusted group.

the maladjusted to show greater differences on paired items of similar maturity than the adjusted children. The sum of the differences for the adjusted group is 154, while for the maladjusted, it is 170. The difference of 16 per cent between the groups is not very large and does not appear to be significant A closer examination of Table 3 shows that the differences in success that exist between the adjusted and maladjusted is 0 or 1 on four of the 10 pairs of items. On the remaining six pairs of items, the maladjusted group shows a greater difference of success on three pairs than the adjusted children This is reversed in the three other pairs of items and the adjusted group shows a greater difference in success than the maladjusted.

These results are not in harmony with the hypothesis suggested by Goodenough The maladjusted group does not present a clear cut difference of success on items of similar maturity from that presented by the adjusted group Both groups appear to do equally well on these items.

D SUMMARY AND CONCLUSIONS

The purpose of this study was to ascertain whether the objective items of the Goodenough drawing scale differentiated between intellectually normal children who differed significantly in regard to behavior adjustment and who could be considered as maladjusted and adjusted groups The children of both groups ranged from six to 12 years in chronological age, with a mean of nine years There were 409 boys and girls in the adjusted group and 330 in the maladjusted group The groups differed significantly from each other in regard to the incidence of behavior problems and problem tendency scores as measured by the Haggerty-Olson-Wickman Their scores on the Goodenough drawing scale indicated that there was no difference between the means of the adjusted and maladjusted groups

An item analysis of the Goodenough scale indicated that there were no reliable differences between the adjusted and maladjusted groups on 36 of the 51 items On the remaining 15 items, the maladjusted were more frequently successful on nine, while the adjusted were more successful on six items There was a tendency for the maladjusted to include more details in their drawings, while the adjusted were slightly better on items which involved motor coordination and correct proportions. There was, however, a great deal of overlapping in the per cent of success on each item between the two groups, and it was impossible to differentiate the adjusted from the maladjusted

A negligible per cent of both the adjusted and maladjusted groups gave those qualitative responses which are characterized as "verbalist" and "individual" responses

An analysis of the combination of primitive and mature characteristics found in the drawings was made. This did not reveal any substantial difference of success by the adjusted group over the maladjusted.

The general conclusion of this study is that the various items of the Goodenough scale do not differentiate between intellectually normal groups of school children who show behavior deviations The scale fails to differentiate adjusted children from maladjusted ones.

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The Journal of Genetic Psychology, 1941, 58, 139-150

A COMPARISON OF A GROUP OF NINTH AND TENTH GRADE DELINQUENT AND NON-DELINQUENT BOYS AND GIRLS ON CERTAIN ATTITUDE SCALES*

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A. INTRODUCTION

This study is an attempt to compare certain attitudes expressed by a group of institutionalized delinquent boys and girls with those expressed by a group of high school students, where both groups are approximately equated with respect to such factors as age, intelligence, and educational status.

Three of the Thurstone, *et al.*, *Scales for the Measurement of Social Attitudes* (Form *A*) were used: Attitude toward the Law, Attitude toward the Reality of God, and Attitude toward the Church. These particular attitudes were chosen for study because it seemed likely that they might be significantly correlated with delinquent behavior. It should be noted that, in accordance with the usage of the tests themselves, a favorable attitude is indicated by a high score on the law and God scales, and a low score on the church scale.

The three attitude scales were administered to 116 boys in the Indiana Boys' School, Plainfield, Indiana, to 49 girls in the Indiana Girls' School, Indianapolis, Indiana, and to 91 boys and 42 girls in the Greencastle, Indiana, High School. All those taking the tests were in the 9th or 10th grades, with the exception of one high school graduate in the Indiana Girls' School. This number

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*Received in the Editorial Office on November 15, 1939.

[1] Thanks are due the following persons: Mr. Paul Boston and Mr. William Bishop, superintendent and principal, respectively, of the Greencastle, Indiana, high school; Mr. O. J. Breidenbaugh and Mr. Cornelius Abbott, psychologist and principal, respectively, of the Indiana Boys' School, Plainfield, Indiana; Miss Mary Ellen Thrasher and Miss Kenosha Sessions, psychologist and superintendent, respectively, of the Indiana Girls' School, Indianapolis, Indiana; Miss Miriam Ransburg, DePauw University, for administering and scoring the tests for the girls in both the Indiana Girls' School and the Greencastle High School.

includes, with the exception of a few who invalidated their scores on one or more of the attitude scales, all of the 9th and 10th grade boys and girls in the delinquent schools

In order to secure pertinent information about the subjects under investigation, a personal data sheet, consisting of 19 items, was used The files of the two delinquent institutions furnished Stanford-Binet *IQ*'s and a *record of the court charge under which each* delinquent had been committed. Terman *Group Test* scores were available for all the high school pupils, and Stanford-Binet *IQ*'s were secured for all but a few of them

The personal data were divided roughly into four more or less arbitrary categories. (*a*) general information, (*b*) the relationships of the individual with groups which are generally acknowledged to build, or have as their avowed purpose the building of, character, (*c*) the economic status of the family; (*d*) conditions of home life Included under "general information" were such data as class in school, *IQ*, age, and place of residence Included under "relationships with character-building agencies" were data pertaining to Scouting, attending a "Y" (there is no "Y" for either boys or girls in the high school group), and church affiliation and activity

The two personal data items which indicated in a general way the economic status of the groups were. (*a*) occupation of the father; and (*b*) home ownership. The occupations of the fathers were, in general, classifiable into one or another of the following categories:

Proprietorial (owner of a store, bank, factory, etc)
Professional (physician, lawyer, teacher, etc)
Managerial (any directing position, public or private)
Commercial (buying and selling, other than proprietorial)
Clerical (accounting, bookkeeping, cashier, etc.)
Manual labor (all forms, other than agricultural)
Agricultural (all forms)

Also, it was found necessary to include three additional categories—one each for those whose fathers were on relief, were retired, or were deceased The personal data items which gave some insight into home life were· (*a*) marital status of the parents, (*b*) number of other children in the family, (*c*) church relationships of the parents; (*d*) education of the parents.

B Results and Discussion

1. *Differences in Personal Data and Attitudes between the Delinquent and the Non-Delinquent Boys*

A comparison of the delinquent and non-delinquent boys reveals that the latter have a mean *IQ* approximately six points higher than the former, although both means fall well within the range which Terman classifies as average. The delinquents are slightly more homogeneous in intelligence. While most of the non-delinquent boys live in a community of less than 5,000 population (over one-fourth of them actually live on the farm), approximately 70 per cent of the delinquent boys come from towns having a population in excess of 5,000, and less than 10 per cent come from the farm We are thus not only measuring the attitude differences between delinquent and non-delinquent groups, but also, to some extent, between urban and rural groups

As far as relationships with character-building organizations are concerned, approximately one-fourth of both groups of boys are, or have been, Boy Scouts Nearly 20 per cent more delinquents claim church membership than do non-delinquents The high school boys enjoy a slightly better economic status Ten per cent of the delinquents have fathers who are on relief, and over 10 per cent report their fathers as deceased. In addition, a larger percentage of the fathers of high school boys are in the higher occupational groups The majority of the fathers in both groups, however, are in the manual labor and agricultural occupational categories.

Only a third of the delinquent boys say that their parents own the home in which they live, while slightly more than half of the non-delinquents report that their parents are home owners The delinquent boys come from inferior homes in many respects, nearly 50 per cent of them are from homes that have been broken by separation, divorce, or death. On the other hand, only 10 per cent of the non-delinquents are from broken homes Moreover, the parents of the high school boys have a higher educational status than those of the delinquents In both groups the mothers have a slightly better education than the fathers

A majority of both the fathers and the mothers of the non-delinquent boys are church members, but, surprising as it may seem, nearly twice as large a group of the fathers of delinquent boys are reported to attend Sunday school. The mothers of the delinquents attend both church and Sunday school more regularly than do the mothers of the non-delinquents. The delinquent boys come from slightly larger families and tend to be among the older children in the family, while the non-delinquents tend to be among the younger.

The medians, means, and *SD*'s of the scores of the two groups of boys on the three attitude scales (law, God, church) are shown in Table 1. It will be noted that there is no difference between the mean and median scores of the two groups with reference to their attitudes toward the reality of God. Apparently, there is little, or no, relationship between contact with character-building institutions and belief in God, or between the religious participation of the parents and such belief. However, there is a difference in favor of the non-delinquent boys both in attitudes toward the law and toward the church. The differences between the median scores, and the reliability of the differences, are shown in Table 2. There are 80 chances in 100 that the obtained difference in favor of the high

TABLE 1
MEDIANS, MEANS, AND *SD*'S ON THREE ATTITUDE SCALES FOR A GROUP OF DELINQUENT AND A GROUP OF NON-DELINQUENT 9TH AND 10TH GRADE BOYS

Groups	*N*	Law			God			Church		
		Mdn	Mn	*SD*	Mdn	Mn	*SD*	Mdn	Mn	*SD*
Delinquents	116	6.90	6.88	.68	7.40	7.43	.98	3.60	3.77	1.06
Non-delinquents	91	7.00	6.91	.73	7.40	7.41	.88	3.50	3.87	1.15

TABLE 2
DIFFERENCE BETWEEN MEDIAN SCORES ON THREE ATTITUDE SCALES, AND RELIABILITY OF THE DIFFERENCE, FOR A GROUP OF DELINQUENT AND A GROUP OF NON-DELINQUENT 9TH AND 10TH GRADE BOYS

Group	Law			God			Church		
	*Diff**	*σdiff*	$\frac{Diff}{\sigma diff}$	*Diff*	*σdiff*	$\frac{Diff}{\sigma diff}$	*Diff.*	*σdiff*	$\frac{Diff}{\sigma diff}$
Delinquents									
Non-delinquents	*.10*	*.12*	*.83*				*.10*	*.20*	*.50*

*The difference between the median scores of the two groups is printed in the same row as the name of the group having the more favorable score.

school boys with respect to their attitude toward the law is a true difference. Perhaps the decided difference between the two groups in the size of place of residence is an important factor in accounting for this difference in attitude Smaller communities, where informal primary-group social controls are more likely to be effective, probably tend to produce and foster a greater respect for law. The superior economic status of the non-delinquents might also operate to produce this difference in attitude. Conversely, among the delinquent boys, the larger proportion of broken homes, and the slightly larger families, would tend to result in a lack of parental control and guidance, and in the consequent necessity for such children to shift for themselves.

There are 69 chances in 100 that the obtained difference in favor of the high school boys with respect to their attitude toward the church is a true difference This more favorable attitude is reflected by the higher proportion of church membership on the part of their parents However, on the basis of amount of church participation on the part of the parents (as reported by the two groups of boys), one would expect that the delinquents might have a more favorable attitude toward the church, *if* such activity on the part of parents may be expected to influence the attitudes of their children

2 *Differences in Personal Data and Attitudes between the Delinquent and the Non-Delinquent Girls*

A comparison of the delinquent and non-delinquent girls reveals that there are less than three points difference in the mean *IQ*'s of the two groups, the delinquents are slightly less intelligent and form a more homogeneous group. A marked rural-urban division is indicated between the two groups of girls Most of the high school girls live in a community of less than 5,000 population (approximately one-fourth of them actually live on the farm) On the other hand, slightly over 60 per cent of the delinquent girls come from towns having a population in excess of 5,000, and less than 10 per cent of them come from the farm

As far as relationships with character-building agencies are concerned, approximately 15 per cent of both groups of girls are, or have been, Girl Scouts. Slightly more than half of both groups claim church membership, approximately an equal proportion attend Sunday school regularly, but almost twice as large a percentage of the non-delinquents attend church regularly.

The high school girls enjoy a better economic status. None of the non-delinquents, but 10 per cent of the delinquents have fathers on relief. Also, a larger proportion of the fathers of non-delinquents are to be found in the upper occupational categories. Less than one-third of the delinquent girls say that their parents own their homes, while 40 per cent of the non-delinquents report that their parents are home owners. Over one-third of the delinquent girls are from broken homes. In contrast, only about 10 per cent of the high school girls come from homes that have been disrupted by divorce, separation, or the death of a parent. The parents of the non-delinquents have a better average education than those of the delinquents. In both groups of girls the mothers have a slight educational advantage over the fathers, although this is not marked in the case of the non-delinquents.

Half again as large a percentage of the fathers of the non-delinquent girls are church members, but a slightly larger percentage of the fathers of the delinquents are reported to attend Sunday school and church regularly. Approximately an equal percentage of the mothers of both groups of girls are church members, but twice as large a proportion of the mothers of the delinquents are reported to be regular attendants at both Sunday school and church. The high school girls come from smaller families, and tend, on the average, to be slightly older than most of their brothers and sisters. On the other hand, the delinquents tend to be slightly older than most of their brothers, and slightly younger than most of their sisters.

The means, medians, and *SD*'s of the scores of the two groups of girls on the three attitude scales are shown in Table 3. It will be

TABLE 3

Medians, Means, and *SD*'s on Three Attitude Scales for a Group of Delinquent and a Group of Non-Delinquent 9th and 10th Grade Girls

Groups	*N*	Law Mdn	Law Mn	Law *SD*	God Mdn	God Mn	God *SD*	Church Mdn	Church Mn	Church *SD*
Delinquents	49	7.20	7.12	85	8.40	8.39	89	2.30	2.42	78
Non-delinquents	42	6.40	6.62	1.09	5.90	6.19	1.59	3.20	5.93	1.18

noted that the delinquents have a more favorable score on all three attitude scales. The differences between the median scores and the reliability of the differences, are shown in Table 4 On all three scales there are 100 chances in 100 that the obtained differences are true differences It must be admitted that these results are contrary to what one would expect. The authors offer no explanation, inasmuch as the genesis of attitudes is so complex that it eludes exact analysis

TABLE 4

Difference Between Median Scores on Three Attitude Scales, and Reliability of the Difference, for a Group of Delinquent and a Group of Non-Delinquent 9th and 10th Grade Girls

	Law			God			Church		
Group	*Diff* *	$\sigma diff$	$\frac{Diff}{\sigma diff}$	*Diff*	$\sigma diff$	$\frac{Diff}{\sigma diff}$	*Diff*	$\sigma diff$	$\frac{Diff}{\sigma diff}$
Delinquents	80	26	3 08	2 50	35	7 14	90	27	3 33
Non-delinquents									

*The difference between the median scores of the two groups is printed in the same row as the name of the group having the more favorable score

3. *Differences in the Personal Data and Attitudes between the Delinquent Boys and Girls*

A comparison of the delinquent boys and girls reveals that there is less than five points difference in favor of the boys in the mean *IQ*'s of the two groups A somewhat larger percentage of the boys come from large cities, while well over half of both groups come from communities having a population in excess of 5,000 As far as relationships with character-building agencies are concerned, the boys appear to have the advantage. Approximately one-fourth of the boys are, or have been, Scouts, whereas only slightly more than one sixth of the girls have participated in Scouting. More boys than girls claim church membership, they report that they attend church more often than the girls, but go to Sunday school less regularly

The economic status of the two groups is about the same Approximately 10 per cent of the fathers of both groups are on relief Slightly more than 10 per cent of the fathers of the boys are deceased, all the girls' fathers are living Only about 5 per cent of the fathers of both groups are in the upper occupational categories. Over half of the fathers of both sexes are classified in the manual labor and agricultural occupational groups, with twice as large a percentage of the girls' fathers living on farms About one-third of both groups report that their parents own their homes. Approximately 50 per cent of the boys' parents, and 65 per cent of the girls' parents, are living together However, a much larger percentage of the broken homes among the delinquent girls is caused by separation and divorce than is the case among the boys In general, the parents of the boys have a better education

With respect to the church relationships of the parents of the two groups, the fathers of the boys are reported to be church members more frequently than are the girls' fathers, and they attend Sunday school and church more regularly However, as for the girls, their mothers hold church membership more frequently than do the mothers of the boys, and they, too, attend Sunday school and church more regularly. The girls come from larger families than do the boys, they tend to be older than many of their brothers, and younger than most of their sisters, occupying a position in the family slightly older than the middle child The boys, on the other hand, tend to be older than a majority of both their brothers and their sisters

One of the most significant sex differences among the delinquents is to be found in the classification of their offenses. Some difficulty in determining classification was encountered, because, according to the Indiana law, the only charge under which a child may be committed to a state institution is "delinquency" Some judges, especially those presiding over juvenile courts in large cities, follow this law very strictly. Other judges, however, include the charge under which the defendant would have been tried had he been an adult Approximately one-third of each delinquent group is unclassifiable because the court charge is simply "delinquency" The remainder may be classified under four general heads.

Offenses against property (stealing, petty larceny, etc.)
Offenses against the person (robbery, assault, etc)
Offenses of a sex nature (rape, cohabitation, etc)
Offenses against social regulations (truancy, intoxication, running away from home, etc)

Sixty per cent of the boys are charged with offenses against property, about two per cent with offenses against the person, less than one per cent (one case) with an offense of a sex nature, and less than five per cent with offenses against social regulations. On the other hand, less than 10 per cent of the girls are charged with offenses against property, none with offenses against the person, 20 per cent with offenses of a sexual nature, and nearly 40 per cent with offenses against social regulations.

The means, medians, and *SD*'s of the scores of the two groups of delinquent boys and girls on the three attitude scales are shown in Table 5. It will be noted that in each scale the girls have a more favorable attitude than the boys. The differences between the median scores, and the reliability of the differences, are shown in Table 6. There are 96 chances in 100 that the obtained difference in favor of the delinquent girls with respect to attitude toward law is a true difference. There are 100 chances in 100 that the obtained difference in favor of the girls in their attitudes toward God and toward the church are true differences.

TABLE 5

MEDIANS, MEANS, AND *SD*'S ON THREE ATTITUDE SCALES FOR A GROUP OF DELINQUENT 9TH AND 10TH GRADE BOYS AND GIRLS

		Law			God			Church		
Groups	*N*	Mdn	Mn	*SD*	Mdn	Mn	*SD*	Mdn	Mn	*SD*
Boys	116	6.90	6.88	68	7.40	7.43	.98	3.60	3.77	1.06
Girls	49	7.20	7.12	85	8.40	8.39	89	2.30	2.42	.78

TABLE 6

DIFFERENCE BETWEEN MEDIAN SCORES ON THREE ATTITUDE SCALES, AND RELIABILITY OF THE DIFFERENCE, FOR A GROUP OF DELINQUENT 9TH AND 10TH GRADE BOYS AND GIRLS

	Law			God			Church		
Group	*Diff* *	$\sigma diff$	$\frac{Diff}{\sigma diff}$	*Diff*	$\sigma diff$	$\frac{Diff}{\sigma diff}$	*Diff*	$\sigma diff$	$\frac{Diff}{\sigma diff}$
Boys									
Girls	30	17	1.76	1.00	20	5.00	1.30	41	3.10

*The difference between the median scores of the two groups is printed in the same row as the name of the group having the more favorable score.

The sex difference in attitude toward law may probably be explained by the fact that the girls are, for the most part, committed for different types of crimes than are the boys. The boys are charged with offenses against property, where legal regulation has always been strong. The girls, on the other hand, are charged with offenses against social regulations and offenses of a sex nature—crimes of a more strictly moral character. Moreover, the girls are more likely to come from homes which have been broken by separation or divorce, a circumstance which is usually accompanied by emotional tension in the home. The delinquencies of the girls are perhaps not related to their attitude toward the law, but rather to a disorganized home life.

4. *Differences in the Personal Data and Attitudes between the Non-Delinquent Boys and Girls*

A comparison of the non-delinquent boys and girls reveals that there is a difference of eight points in the mean *IQ* in favor of the boys; the girls form a slightly more homogeneous group. About 15 per cent of the girls are Scouts, as compared with 25 per cent of the boys. More boys than girls come from the farm. About 50 per cent of the boys, and 60 per cent of the girls, belong to some church, although twice as large a percentage of girls report that they attend Sunday school and church regularly. The boys seem to have a slightly superior economic status, with a larger percentage of their fathers in the higher occupational categories. Fewer boys than girls have fathers engaged in manual labor, but a slightly larger percentage have fathers who are farmers. The marital status of the parents of both high school groups is practically the same, with 90 per cent of the parents living together.

Somewhat less than 50 per cent of the fathers in both groups are church members, about 10 per cent are reported to attend Sunday school regularly. Approximately 65 per cent of the mothers of both groups are church members, but one-third more of the girls' mothers attend Sunday school and church regularly. The girls tend to come from larger families than the boys, and to have fewer older brothers and sisters.

The means, medians, and *SD*'s of the scores of the high school groups on the three attitude scales are shown in Table 7. It will be noted that the girls have a more favorable attitude toward the church, while the boys are more favorable toward belief in God and

TABLE 7

MEDIANS, MEANS, AND *SD*'S ON THREE ATTITUDE SCALES FOR A GROUP OF NON-DELINQUENT 9TH AND 10TH GRADE BOYS AND GIRLS

		Law			God			Church		
Groups	*N*	Mdn	Mn	*SD*	Mdn	Mn	*SD*	Mdn	Mn	*SD*
Boys	91	7 00	6 91	73	7 40	7 41	88	3 50	3 87	1 15
Girls	42	6 40	6 62	1.09	5 90	6 19	1 59	3 20	5 93	1 18

TABLE 8

DIFFERENCE BETWEEN MEDIAN SCORES ON THREE ATTITUDE SCALES, AND RELIABILITY OF THE DIFFERENCE, FOR A GROUP OF NON-DELINQUENT 9TH AND 10TH GRADE BOYS AND GIRLS

	Law			God			Church		
Group	*Diff**	$\sigma diff$	$\frac{Diff}{\sigma diff}$	*Diff*	$\sigma diff$	$\frac{Diff}{\sigma diff}$	*Diff*	$\sigma diff$	$\frac{Diff}{\sigma diff}$
Boys	60	23	2 61	1 50	33	4 55			
Girls							30	22	1.36

*The difference between the median scores of the two groups is printed in the same row as the name of the group having the more favorable score

respect for law. The differences between the median scores, and the reliability of the differences, are shown in Table 8 There are 91 chances in 100 that the obtained difference in favor of the girls with respect to their attitude toward the church is a true difference The more favorable attitude toward the church on the part of the girls is reflected in the much higher percentage of girls who report regular Sunday school and church attendance There are 100 chances in 100 that the obtained difference in favor of the boys with respect to their attitude toward the reality of God is a true difference There are 99 5 chances in 100 that the obtained difference on attitude toward law in favor of the boys is a true difference

C SUMMARY

The results of this study may be summarized as follows (all conclusions are tentative and apply only to the institutions in which the investigation was made)

1. High school boys are more favorable in their attitudes toward the law and the church than are delinquent boys, there is no difference in their attitude toward the reality of God

2 Delinquent girls are more favorable in their attitudes toward law, reality of God, and the church than are high school girls

3. Delinquent girls are more favorable in their attitudes toward law, reality of God, and the church than are delinquent boys.

4 High school boys are more favorable than high school girls in their attitudes toward law and reality of God, but are less favorable toward the church

5 The scores of high school girls vary more from the central tendency than do the scores of delinquent girls with respect to all three attitude scales The scores of high school boys vary more from the central tendency than do the scores of delinquent boys with respect to their attitudes toward law and the church, delinquent boys are more variable in their attitudes toward reality of God

6 The sex difference in attitude toward the law is in favor of the boys in the non-delinquent group, it is larger and more reliable than the sex difference in the delinquent group, where the difference is in favor of the girls The sex difference in attitude toward the reality of God is in favor of the boys in the non-delinquent group, it is larger than the sex difference in favor of the girls in the delinquent group In both groups these attitude differences are reliable The sex difference in attitude toward the church is in favor of the delinquent girls, it is larger and more reliable than the sex difference in favor of the girls in the non-delinquent group

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The Journal of Genetic Psychology, 1941, 58, 151-159

COMPARISON OF STANFORD-BINET AND KENT ORAL EMERGENCY SCORES*

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We have been using the Kent *Oral Emergency Test* (3) for three years and in this period of time have given several hundred of these tests We prefer this test for three distinct reasons We find it a very good test with which to begin our testing procedure, particularly with adults who sometimes approach the examination with apprehension Due to the fact that the test can be administered quite informally and in a conversational manner, it is an excellent vehicle for the beginning of an examination Secondly, we find the qualitative responses quite as interesting as the quantitative scores, particularly with illiterate and foreign-born individuals In the third place, the test has proved to be a good supplementary test, particularly when the testing period is limited and there is time for but one brief test in addition to the Stanford-Binet or other test of general intelligence being used

Our present study was undertaken for two reasons. We had long observed that subnormal individuals tended to make a higher rating on the Kent *Oral* than they did on the Stanford-Binet We were also interested in comparing our results with those obtained by Elwood, Burchard and Teagarden (2), a study hereafter referred to as the Pittsburgh study These writers found surprisingly high correlations between results on the Kent and the Stanford-Binet in 325 cases They also found that discrepancies between the Kent and Binet scores were perhaps occurring more frequently in psychotic cases and in cases of behavior disorders, and suggested further study on this point We decided to carry on a somewhat similar investigation using the 1937 revision of the Stanford-Binet (5) It will be noted that the older revision of the Binet was used in the Pittsburgh study As the Kent test is used almost routinely by us, we selected about 300 cases during 1937. Of this group 50 had

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*Accepted for publication by Leonard Carmichael of the Editorial Board, and received in the Editorial Office on November 16, 1939

been given Form *M*, and the remainder, Form *L* of the Binet. The Kent test was given by four different examiners. Our subjects were individuals coming under the jurisdiction of the State Department of Public Welfare and are classified as in Table 1.

TABLE 1

Neglected and dependent children	66
Institutionalized feebleminded	49
Institutionalized delinquent boys	42
Institutionalized delinquent girls	21
Prisoners	45
Hospital clinics	32
Hospitals	23
Probation	6
Others	2
Total	286

Results on 286 individuals are included in the study although 300 cases were originally set aside for use. The reduction in the number of cases is due to the fact that in some instances, when the Kent test was rescored according to the Pittsburgh norms (4), the score fell either above or below the norms and consequently could not be used for statistical purposes. Our subjects are divided according to age and sex as given in Table 2.

TABLE 2

	Under 15 years	15 years and over	Total
Male	90	80	170
Female	37	79	116

Our numerical boundaries are indicated in Table 3.

TABLE 3

CA range	4 years, 11 months to 72 years
Stanford-Binet *MA* range	3 years, 9 months to 20 years, 4 months
Stanford-Binet *IQ* range	30 to 136
Kent *MA* range	5 years, 1 month to 15 years, 1 month

It is interesting to note that of all the individuals tested, only one having a Binet mental age of over 14 years scored above the Kent norms, and consequently could not be given a more definite Kent *MA* than that of "over 15-1." Similarly, the Pittsburgh investigators (2) found that not one of their subjects with a Binet mental age of over 14 years was penalized by scoring above the Kent norms

The tabulation of our final results indicates that 286 individuals are being considered, 45 of whom had the Form *M* of the Revised Stanford-Binet and 241, Form *L* Sixty-four were tested on the Lower, or Scale I, of the Kent, 27 on the Middle, or Scale II, four on the Upper, or Scale III, 72 on Scales I and II, 40 on Scales I, II and III, 78 on Scales II and III and one on Scales I and III In all, then 177 were given Scale I, 217 were given Scale II, and 123 were given Scale III In some instances, where an individual had originally been given two or more scales, it was possible to use the result of but one scale as the score on the other scales were too high or low for the revised norms It is customary for us to give at least two scales and in clinical practice where more than one scale is given, we use the average of two scale levels in reporting our results For present statistical purposes, we have used the Pittsburgh scoring technique (4) Kent *IQ*'s were used only for the present study, as we find no particular advantage in using them in our clinical work, where we prefer a more general Kent mental age rating

It might be well to point out that our subjects represent a somewhat selected group, chosen by us in the order of testing during one year and not selected on the basis of age, *IQ* rating, sex, or institution However, most of the cases coming to our attention are individuals who have not been able to fit into society There are some exceptions to this, of course, largely in our group of neglected and dependent children Even here, however, we find that the average *IQ* for the past few years has been somewhat below normal (in 1937 the average *IQ* for 124 cases was 82 3), and many of these children seem unable to adjust in foster homes and are "return" cases when tested in the institution. The majority of our subjects are delinquent boys and girls, adult offenders, and institutionalized feebleminded Not more than 25 per cent of the group might be called normal or well-adjusted individuals

We are reporting in Table 4 our correlations between *IQ*'s on the various Kent scales, and between Kent *IQ*'s and Binet *IQ*'s. We are reporting no correlation between Scale I and Scale III as we had only one case in this group

In comparing the various Kent scales we find about the same high

TABLE 4

PRODUCT MOMENT CORRELATIONS BETWEEN *IQ*'S ON KENT AND STANFORD-BINET

Tests	Number of cases	Pearson *r*	*PE*
Kent Low and Binet	177	84	015
Kent Middle and Binet	217	69	024
Kent Upper and Binet	123	69	031
Kent Low and Kent Middle	72	96	006
Kent Middle and Kent Upper	78	84	023

correlations, but our correlations are considerably lower than those reported by Elwood, Burchard, and Teagarden where the Binet test has been compared with the Kent. The discrepancies may be due partly to the fact that the last Terman revision is undoubtedly a more accurate measuring instrument than the previous revision of the Binet and does not tend to favor the feebleminded, as we believe the Kent test does, and as the older Binet test is thought to have done in some cases This is merely an opinion, but at any rate, two different Binets have been used, and the resulting ratings are not strictly comparable

TABLE 5

DEVIATION IN MONTHS OF KENT *MA*'S FROM BINET *MA*'S

Kent Less Than Binet

Months

	77-92	76	72	68	64	60	56	52	48	44	40	36	32	28	24	20	16	12	8	4
Low Scale Number = 50											1	1	1	3	2	6	3	3	12	18
Middle Scale Number = 103	1			1		1	1	4	1		1	2	8	7	13	9	7	13	18	16
Upper Scale Number = 74		1				2	1	1	1	3	4	5	4	8	7	8	4	18	2	5

Kent More Than Binet

	Same	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64
Low Scale Number = 127	9	23	20	18	12	21	4	12	4	2	1				1		
Middle Scale Number = 114	10	24	16	20	9	11	6	6	4	2	1	1	2		1		1
Upper Scale Number = 49	5	11	10	4	7	3	4	1		2	1	1					

The deviation in months of all Kent mental ages from Binet mental age is indicated in Table 5.

A study of Table 5 indicates a wide deviation of Kent mental age above and below the corresponding Stanford-Binet mental age To be more specific, we find that 58 per cent of the 177 cases on the Kent *Lower Scale* fall 12 months above to 12 months below the corresponding Stanford-Binet mental age On the Kent *Middle Scale,* 54 per cent of our 217 cases fall 12 months above to 12 months below the Stanford-Binet mental age, while on the Kent *Upper Scale,* 54 per cent of our 123 cases fall 16 months above to 16 months below the Stanford-Binet mental age While, however, we find more than one half of our cases within reasonable limits of deviation, we observe some wide divergencies both above and below the Binet Further analysis of these cases yields the following information Fifty cases are reported where the Kent mental age is at least 20 months below the Stanford-Binet mental age and 44 cases appear where the Kent mental age is at least 20 months above the Stanford-Binet mental age A most significant fact was apparent upon further study of these cases showing such wide differences Of the 44 cases where the Kent mental age was at least 20 months more than the Stanford-Binet mental age, 40 out of the 44 had *IQ*'s of 70 or less and the other four cases had *IQ*'s of 76, 78, 102, and 110 respectively. Of the 50 cases where the Kent was at least 20 months less than the Stanford-Binet mental age, not one case could be classified as feebleminded This rather clear-cut picture showed a good-sized group of feebleminded individuals making a much higher score on the Kent than on the Binet and another group, made up chiefly of "problem" cases, none of whom had an *IQ* below 70, getting a lower rating on the Kent than on the Stanford-Binet, more or less substantiating our belief that feebleminded individuals tend to make a higher rating on the Kent than on the Stanford-Binet, and suggesting, at least, that mal-adjusted though not feebleminded individuals tend to rate lower, as the Pittsburgh workers had observed

On the basis of the Binet *IQ* we divided all scores into two groups, those with *IQ*'s of 70 or below and those with *IQ*'s above 70. We then found the average difference between mental ages on the Kent and on the Binet for each of the three Kent scales In each instance the sub-normal group made an average score above their Binet mental age, and the group with *IQ*'s above 70 scored below their Binet mental age. Table 6 will illustrate this point more specifically.

TABLE 6

AVERAGE DEVIATION IN MONTHS OF KENT *MA*'S FROM BINET *MA*'S FOR EACH KENT SCALE

	Number of cases	Kent mental age Average deviation
Lower Scale		
Binet *IQ* 70 and under	112	13.15
Binet *IQ* over 70	67	—2.49
Middle Scale		
Binet *IQ* 70 and under	88	14.9
Binet *IQ* over 70	129	—12.45
Upper Scale		
Binet *IQ* 70 and under	28	15.14
Binet *IQ* over 70	93	—16.57

In each of the three scales it will be observed that the feebleminded consistently make a higher rating on the Kent scale than do individuals with *IQ*'s above 70. This differs from the results reported in the Pittsburgh study, but our findings are not really at odds. Let us consider the results of the two studies. While the Pittsburgh workers (2) found that psychotic or state hospital patients tended to obtain much higher ratings on the Kent than they *did on the Binet, we have found that the feebleminded* tend to rate much higher on the Kent. However, we have not tested many psychotic cases and we do not know just how many feebleminded individuals were tested by the Pittsburgh workers, so these groups are really not comparable, even though showing similar psychometric pictures. It would certainly be interesting to know if the same situation might exist were the Pittsburgh cases divided on the the basis of sub-normal and above 70 *IQ* rating. We do not know why psychotics do so well on the Kent test but perhaps it is for the same reason that they tend to make a better rating on the Stanford-Binet vocabulary test than on the entire Stanford-Binet scale. As far as the feeble-minded are concerned, we feel that this test contains many items of an acquired routine nature which are apparently easy for sub-normal individuals.

The second point suggested by Elwood, Burchard, and Teagarden

(2) was that the majority of their subjects who rated materially lower on the Kent than on the Binet were Psychological Clinic cases referred for behavior disorders which could not be explained on the basis of intelligence alone In our study we have found that individuals who have *IQ*'s of above 70 consistently make a lower score on the Kent scale than they do on the Stanford-Binet, and the majority of these individuals might be classified as behavior problems, using this category in its very broadest sense, and have manifested anti-social behavior which is not explainable solely on the basis of intelligence An interesting fact here is that the Pittsburgh workers saw as significant the personality or behavior traits while we were led to stress the intellectual factors, but these two different categories do not seem mutually exclusive on further analysis of our cases. Perhaps this would hold true also in the Pittsburgh study.

It might be well to discuss briefly some of the individuals who deviated so widely on the Kent above and below the Binet. As already pointed out, 40 out of the 44 who had Kent mental ages at least 20 months above the Binet mental age had *IQ*'s below 70, and most of them were already committed to institutions for the feebleminded Of the four whose *IQ*'s were above 70, one with an *IQ* of 110 was showing some personality changes and some schizoid traits The mother of another was confined in a state hospital. A third had suffered from poliomyelitis, and the fourth was a dependent child and little was known about the background or history There is little indication here for assuming that psychotics tend to rate higher on the Kent, but, of course, our number of psychotics was very limited Of the group of 50 whose Kent mental age was at least 20 months below the Binet mental age, a few had been classified as psychopathic personalities, one had formerly been committed to a state hospital, two, a brother and sister, had a mother in a state hospital, and several among the group were unmarried mothers. Others were delinquents and wayward, or were serving sentences for various types of crime such as stealing, arson, neglect of children, and cruelty to animals The individual showing the greatest minus deviation was charged with exhibitionism. In this group were six persons who did not seem to fit in with the group. Three of them were children suffering from tuberculosis, two were dependent children and one was an adult who had had poliomyelitis The majority of this group, therefore, appear to be classifiable as "behavior problems."

A more recent study than that of the Pittsburgh workers is reported by Benton (1), with results quite consistent with our findings. Fifty-five children were used as subjects and both forms of the Terman-Merrill revision of the Binet were administered, but only one form to each subject Benton states·

> With children of low intelligence, the Kent scores run somewhat higher than the Binet scores In the case of a group, the average intelligence of which is normal, the mean scores on both tests are almost identical In the case of children of high average or superior intelligence, the Kent scores generally run somewhat lower than the Binet scores

Our correlations between the Binet and Kent *IQ*'s are quite similar to Benton's the latter reporting an *r* of 84. We have, however, a much wider range of *CA*'s, *MA*'s and *IQ*'s, due to the fact that we used many more subjects than Benton did and included adults in our group. Probably for the same reason, we found a greater average difference in *IQ* rating on the two scales Benton reports that in 67 per cent of his cases this difference, disregarding signs, is 9 *IQ* points or less, while we found that the average difference in mental age for each of the three scales was 17 months, 27 months, and 32 months respectively The average *IQ* of Benton's group was within normal limits and he discussed his findings in total Kent *IQ* ratings, while we did not have a normal group and we discussed our findings in terms of both *MA* and *IQ* ratings on the Kent scales, and have analyzed our findings separately for each of the three Kent scales Incidentally, Benton *found no greater average difference* in Kent and Binet *IQ*'s for children showing psychiatric symptomatology than for the supposedly normal group

In conclusion, we may say that we are of the opinion that the Kent Oral test correlates well with the 1937 revision of the Stanford-Binet, and appears suitable for use with both adults and with children. It is qualitatively interesting, useful in establishing rapport, and is an easy test to administer from the point of view of both the examiner and the subject It is better as a supplementary test and ordinarily should not be used alone, particularly since our study shows that feebleminded individuals tend to make too high a rating on this test, probably due to the nature of the test, and that individuals who are at odds with society tend to make too low a rating as compared with their Binet mental age Since our distribution of cases was not normal we cannot say how normal individuals of average intelligence would compare in results on the two tests. We have not been able to find a distinction between the performance of psychotics and the performance of "behavior problems," due to the scarcity of psychotic subjects in our group We agree in one case with the findings reported by Elwood, Burchard, and Teagarden (2), but our results are not really comparable in the other case, due to the fact that our group was made up largely of feebleminded individuals, while psychotics stood out in their group We are also in agreement with Benton's results (1) insofar as our findings may be fairly compared It would be advisable, and no doubt worth while, to do further work with the Kent test, using individuals in state hospitals as subjects and also to obtain ratings on normal groups. It might also be advisable to analyze responses to each question, as the author herself suggests (3), in order that the diagnostic value of each item might be learned

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The Journal of Genetic Psychology, 1941, 58, 161-180

AFTERNOON SLEEP IN A GROUP OF NURSERY-SCHOOL CHILDREN*[1]

The Merrill-Palmer School

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A. INTRODUCTION

Investigations of the sleep of young children began in 1925 with a study by Flemming (5), the material for which was records kept by parents. Foster, Goodenough, and Anderson (6) obtained information in the same way. Both studies reported a higher amount of afternoon sleep than is shown by studies of actual sleeping situations

Studies of the duration of sleep in the nursery school, for the group as a whole, have been reported by Chant and Blatz (3), Boynton and Goodenough (2), Sherman (12), Staples (13), and Beckman (1), in the order named The first reported study involving a longer period of time and showing age groups was that of Reynolds and Mallay (10), which, however, based its findings entirely on afternoon sleep during summer sessions Chant and Blatz, Staples, and Erwin (4) have studied seasonal variations in the duration of sleep The question of whether children sleep more on certain days of the week than on others has been studied by Chant and Blatz and by Scott (11) The effect upon sleep of the number of children sleeping in the room has been studied by Chant and Blatz and by Reynolds and Mallay

The present study of the quantitative aspects of the afternoon sleep of a group of children in a nursery school covers three school years, which is a longer period of observation than is recorded in other studies It includes data on the duration of presleep[2] in rela-

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*Received in the Editorial Office on November 27, 1939

[1] Condensed from a thesis submitted for the M S degree, Kansas State College, 1939 The author wishes to express her appreciation to Miss Mary E Sweeny and Miss Marian E Breckenridge of the Merrill-Palmer School for their interest and suggestions, to Mrs Leone Kell and Professor M C Moggie, both of Kansas State College, the former for guidance in directing the thesis, the latter for assistance in the statistical interpretation of the data

[2] This term is used throughout to mean the length of time taken in going to sleep

tion to sleep and to different days (Mondays and Fridays) of the week, an aspect of the question which has not previously been studied. It adds further data on the duration of afternoon sleep, classified by age groups, on the comparative duration of afternoon sleep in fall, winter, and spring, and on the effect upon sleep of the number of children in the room The findings are compared with those of other studies

B Method

The subjects of the study were 73 children, ranging in age from 2-4 to 5-4, enrolled in the nursery school of the Merrill-Palmer School over a three-year period The school was in session for a total of 509 days, as follows Sept 19, 1934 to June 4, 1935 (163 school days), Sept 16, 1935 to June 12, 1936 (177 school days), Sept. 14, 1936 to June 3, 1937 (169 school days) The number of children attending varied, owing to absences and changes of enrollment The number of days of attendance of individual children varied from 34 to 319 days There was no session during the summer

The investigator was a teacher in the nursery school during the three years covered by the study

All the children stayed at the school for the afternoon nap five days a week, from Monday to Friday The second-floor room where they slept was 57 by 21 feet in dimensions, with three skylights and three windows which, owing to the northern exposure, admitted little light Half of the room was used for play during the morning Each child slept on a canvas cot, with a pad and a sheet under him and a blanket (cotton in warm weather, wool in cold weather) over him Only under special circumstances, as when a new child was overly interested in the group, or a child was very restless, was a screen placed around the cot. Several children who seldom slept while at school rested in adjacent cots at one end of the room. The rest of the cots were placed about two feet from one another

The same schedule was followed each day as the children prepared for sleep. Each child, as he finished the nursery-school dinner, left the table, went to the toilet, and then to the playroom above, where he looked at books or listened to stories until about 12:40. In small groups the children entered the sleeping room and quietly removed their shoes, and were covered with their blankets by the assistant or nursery-school teacher When the entire group was in bed the windows were opened The nursery-school teacher and the assistant, who was a different person in each of the three years, were the only adults in the room

Such methods as adopting an attitude of quiet expectancy that it was time to go to sleep, turning toward the wall a child who was interested in the group, and sitting beside restless children were used in helping children who had difficulty in going to sleep Children who woke earlier than 2:30 lay on their cots until that time. The children rose in small groups, put on their shoes in one corner of the room, and left the sleeping room

Data for the entire group were recorded on a weekly summary sheet, from which they were transferred to the individual records of the children Records were kept of the time the group was in bed, the time each child was asleep, and the time each child woke In recording the time, the nearest five-minute interval was used Closed eyes, cessation of movement, and regular breathing were the criteria for judging when the child was asleep; the reverse for judging when the child woke

C. ANALYSIS OF DATA AND COMPARISON WITH OTHER STUDIES

1 *Duration of Sleep in Three Age Groups*

All the records available for each child were used in ascertaining the duration of sleep of children of 2, 3, and 4 years In some cases the same child appeared in all three age groups. The group of two-year-olds comprised children ranging in age from 2-4 to 2-11, with a mean age of 2-9, for this group of 31 children, 1,342 records were analyzed On a child's third birthday, he was considered to belong to the group of three-year-olds, and on his fourth birthday, to the four-year-olds The group of three-year-olds comprised children ranging in age from 3-0 to 3-11, with a mean age of 3-7, for this group of 51 children, 4,251 records were analyzed. The group of four-year-olds comprised children ranging in age from 4-0 to 4-11, with a mean age of 4-6, for this group of 46 children, 4,734 records were analyzed For 12 children, data were available throughout the three-year period, for the other children, the data covered one or two years, there was one child who did not sleep at school during the entire period of attendance tion to sleep and to different days (Mondays and Fridays) of the week, an aspect of the question which has not previously been studied. It adds further data on the duration of afternoon sleep, classified by age groups; on the comparative duration of afternoon sleep in fall, winter, and spring; and on the effect upon sleep of the number of children in the room The findings are compared with those of other studies

B. METHOD

The subjects of the study were 73 children, ranging in age from 2-4 to 5-4, enrolled in the nursery school of the Merrill-Palmer School over a three-year period. The school was in session for a total of 509 days, as follows Sept 19, 1934 to June 4, 1935 (163 school days), Sept. 16, 1935 to June 12, 1936 (177 school days), Sept 14, 1936 to June 3, 1937 (169 school days) The number of children attending varied, owing to absences and changes of enrollment The number of days of attendance of individual children varied from 34 to 319 days There was no session during the summer

The investigator was a teacher in the nursery school during the three years covered by the study.

All the children stayed at the school for the afternoon nap five days a week, from Monday to Friday The second-floor room where they slept was 57 by 21 feet in dimensions, with three skylights and three windows which, owing to the northern exposure, admitted little light Half of the room was used for play during the morning Each child slept on a canvas cot, with a pad and a sheet under him and a blanket (cotton in warm weather, wool in cold weather) over him Only under special circumstances, as when a new child was overly interested in the group, or a child was very restless, was a screen placed around the cot Several children who seldom slept while at school rested in adjacent cots at one end of the room The rest of the cots were placed about two feet from one another

The same schedule was followed each day as the children prepared for sleep. Each child, as he finished the nursery-school dinner, left the table, went to the toilet, and then to the playroom above, where he looked at books or listened to stories until about 12·40 In small groups the children entered the sleeping room and quietly removed their shoes, and were covered with their blankets by the assistant or nursery-school teacher When the entire group was in bed the windows were opened. The nursery-school teacher and the assistant, who was a different person in each of the three years, were the only adults in the room

Such methods as adopting an attitude of quiet expectancy that it was time to go to sleep, turning toward the wall a child who was interested in the group, and sitting beside restless children were used in helping children who had difficulty in going to sleep Children who woke earlier than 2·30 lay on their cots until that time The children rose in small groups, put on their shoes in one corner of the room, and left the sleeping room

Data for the entire group were recorded on a weekly summary sheet, from which they were transferred to the individual records of the children Records were kept of the time the group was in bed, the time each child was asleep, and the time each child woke In recording the time, the nearest five-minute interval was used Closed eyes, cessation of movement, and regular breathing were the criteria for judging when the child was asleep, the reverse for judging when the child woke

C. ANALYSIS OF DATA AND COMPARISON WITH OTHER STUDIES

1. *Duration of Sleep in Three Age Groups*

All the records available for each child were used in ascertaining the duration of sleep of children of 2, 3, and 4 years In some cases the same child appeared in all three age groups. The group of two-year-olds comprised children ranging in age from 2-4 to 2-11, with a mean age of 2-9, for this group of 31 children, 1,342 records were analyzed On a child's third birthday, he was considered to belong to the group of three-year-olds, and on his fourth birthday, to the four-year-olds. The group of three-year-olds comprised children ranging in age from 3-0 to 3-11, with a mean age of 3-7; for this group of 51 children, 4,251 records were analyzed. The group of four-year-olds comprised children ranging in age from 4-0 to 4-11, with a mean age of 4-6; for this group of 46 children, 4,734 records were analyzed For 12 children, data were available throughout the three-year period, for the other children, the data covered one or two years, there was one child who did not sleep at school during the entire period of attendance.

The mean duration of sleep for each child was calculated on a Marchant calculating machine. The mean for the group and the standard deviation for each group were determined by the standard formula applying to measure in a frequency distribution. Table 1 shows the duration of afternoon sleep for each group, and indicates a slight decrease in duration of sleep with increase in age.

TABLE 1

Duration of Afternoon Sleep in Three Age Groups

Mean age	N	Range (Minutes)	Mean (Minutes)	S.D. (Minutes)
2-9	31	56.4-106.8	77.3	10.9
3-7	51	51.9- 99.6	74.4	9.8
4-6	46	47.6- 89.5	69.1	9.5

The standard error of the mean for the group of two-year-olds was 2.0, for the three-year-olds, 1.4, for the four-year-olds, 1.4. Garrett (7, p. 202) states that the reliability of an obtained mean increases as the standard error of the mean decreases. The difference between the means for the group of two-year-olds and the group of three-year-olds was 2.6, and the standard error of the difference was 2.38, with a critical ratio of 1.12. The chances are only 86 in 100 that this is a significant difference (7, p. 213, Table 34).[3] The formula used for calculating the significance of the difference between two obtained means was:

$$\sigma_D = \sqrt{\sigma_{M_1}^2 + \sigma_{M_2}^2}.$$

The formula used for determining the critical ratio was:

$$R = \frac{M_1 - M_2}{\sigma_D}$$

The difference between the means for the group of three-year-olds and the group of four-year-olds was 5.6, and the standard error of the difference was 1.95, with a critical ratio of 2.86. The chances are 99.75 in 100 that this is a significant difference. The difference between the means for the group of two-year-olds and the group of four-year-olds was 8.2, and the standard error of the difference was 2.39, with a critical ratio of 3.45, which is greater than 3, the arbitrarily accepted standard of a true difference. That is, the data show a slight but true decrease in duration of sleep with increase in age.

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[3] This table was used throughout to show the chances of a significant difference.

It was also found that the two-year-olds, as a group, did not sleep 4.0 per cent of the days they were at school, the three-year-olds, 9.9 per cent; and the four-year-olds, 29.0 per cent. In view of the slight decrease in duration of sleep with increasing age, this finding tends to confirm that of other studies showing that afternoon sleep begins to drop out on the all-or-none principle with increase in age; that is, occasionally a child does not sleep at all, but if he does sleep, he sleeps almost as long as a younger child. Table 2 shows a comparison of the results of the present study and other studies with respect to the percentage of days when some of the children did not sleep, in different age groups.

TABLE 2

Comparison of Data from Various Studies, Showing Percentage of Days When Children Did Not Sleep

Study	Year of study	Age of subjects	Percentage of days when children did not sleep
Flemming (1925)	1925	2-6 to 3-0	20.0
		3-0 to 3-6	14.0
		3-6 to 4-0	20.0
		4-0 to 4-6	50.0
		4-6 to 5-0	31.0
Foster, Goodenough, and Anderson (1928)	1927	2-6 to 2-11	7.4
		3-0 to 3-5	12.5
		3-6 to 3-11	16.7
		4-0 to 4-5	34.2
		4-6 to 4-11	31.7
Reynolds and Mallay (1933)	Summers 1931 & 1932	2-0 to 3-0	2.0
		3-0 to 4-0	45.0
		4-0 to 5-0	50.0
Dales (present study)	1934-5	2-4 to 3-0	4.0
	1935-6	3-0 to 4-0	9.9
	1936-7	4-0 to 5-0	29.0

Table 3 shows in summary a comparison of the mean duration of afternoon sleep in different age groups, as given in various studies, together with differences in the number of children studied, the ages of the children, and the length of time records were kept. The mean duration of sleep given by Flemming (5) and Foster, Goode-

TABLE 3

COMPARISON OF DATA FROM VARIOUS STUDIES ON DURATION OF AFTERNOON SLEEP AND PRESLEEP

Study	Date of study	Place of study	N	Age of subjects (Years and Months)		Record period	Age	Mean presleep (minutes)	Age	Mean sleep (minutes)
Flemming, 1925	1925	Merrill-Palmer School and Kansas State College (records kept by nursery-school parents and AAUW study groups)	78	Under -18						
				-18 to	-24	1 week			2 -2½	128
				2-0	2-6				2½-3	118
				2-6	3-0				3 -3½	145
				3-0	3-6				3½-4	115
				3-6	4-0				4 -4½	83
				4-0	4-6				4½-5	100
				4-6	5-0					
				5-0	5-6					
				5-6	6-0					
Chant and Blatz, 1928	1926-27	St. George's School for Child Study, Toronto	13	2-0	5-0	30 weeks				65 (weekly average)
Foster, Goodenough and Anderson, 1928	1927	Institute of Child Welfare, Univ of Minnesota (records kept by parents)	1186	Under 8-0		1 week			2-6 to 2-11	113.4
									3-0 3-5	105.4
									3-6 3-11	102.0
									4-0 4-5	99.6
									4-6 4-11	90.0
Boynton and Goodenough, 1930	1929	Institute of Child Welfare, Univ of Minnesota	56	2-0	4-11	1 to 16 records per child		34.8		79.0
Sherman, 1930	1929	Washington Child Research Center	22	2-0	3-6	8 months		58.3		89.0

TABLE 3 (*continued*)

Study	Date of study	Place of study	*N*	Age of subjects (Years and months)		Record period	Age	Mean presleep (minutes)	Age	Mean sleep (minutes)
Beckman, 1932	1930	Univ of Chicago	18	2-7 4-3	3-5 5-6	3 months	2-7 3-5 4-3 5-6	27.4 32.3	2-7 3-5 4-3 5-6	78.2 68.4
Wagner, 1933	1929-30 1930-31 Fall 1931	Iowa Child Welfare Research Center	15 19 20			School Year School Year Fall		40.0 42.1 41.3		89.0 72.0
Wagner, 1933	1931-32	Iowa Soldiers' Orphans' Home	42	2-2	5-9	30 days		24.14		97.6
Staples, 1932	1932	University of Nebraska	30	2-9	4-11	8 months	(days outdoors) (days indoors)	29.9 29.3	(days outdoors) (days indoors)	77.4 74.5
Reynolds, 1935	1931 1932	Institute of Euthenics Vassar College	59	2-0	4-11	3 summer sessions	2-0 2-11 3-0 3-11 4-0 4-11	26.0 35.0 38.0	2-0 2-11 3-0 3-11 4-0 4-11	89.0 77.0 57.0
Dales (Present study)	1934-35 1935-36 1936-37	Merrill-Palmer School and Kansas State College	128	2-4	5-0	3 school years	2-4 3-0 3-0 4-0 4-0 5-0	24.4 31.0 34.8	2-4 3-0 3-0 4-0 4-0 5-0	77.3 74.7 69.1

nough, and Anderson (6) is much higher than the figures given in later studies. Data for both these studies were obtained through a questionnaire sent to the homes of the children, and not through direct observation in a nursery school. The mean duration shown in the other studies tends to be slightly higher than that shown in the present study.

However, *the present study confirms the results of other studies* in showing a decrease in duration of sleep with increasing age. The evidence that the four-year-old not only sleeps a little less than a younger child, but also sleeps in the afternoon according to the all-or-none principle—occasionally failing to sleep at all during this period—may be of help to adults who are unaware of this changing sleep pattern and sometimes fail to realize that the child is growing older.

2. *Duration of Presleep*

The duration of presleep was studied on the basis of the same age groups and records used in determining the duration of sleep. Since the children went to bed as a group, this period was measured from the time when the entire group was in bed and the windows were opened, not from the time the individual child was in bed, the interval between the time the first child and the last were in bed was no more than five minutes.

The data are shown in Table 4. For the group of two-year-olds the standard error of the mean was 1.3, for the three-year-olds, 1.4; for the four-year-olds, 1.4. That is, the standard error was very small and about the same for all three groups. The difference between the mean for the group of two-year-olds and three-year-olds was 6.6 minutes, and the standard error of the difference was 1.94 minutes, with a critical ratio of 3.5, which is larger than 3.0, the

TABLE 4

DURATION OF PRESLEEP IN THREE AGE GROUPS

Mean age	*N*	Duration of presleep Range (minutes)	Mean (minutes)	*SD* (minutes)
2-9	31	11.1-43.5	24.4	7.5
3-7	51	13.8-63.0	31.0	10.2
4-6	46	11.9-51.4	34.8	9.6

arbitrarily accepted standard of a true difference The difference between the mean for the three-year-olds and four-year-olds was 3.8 minutes, and the standard error of the difference was 2 0, with a critical ratio of 1.9 The chances are 98 in 100 that this is a significant difference The difference between the mean for two-year-olds and four-year-olds was 10 4, and the standard error of the difference was 1 93, with a critical ratio of 5 4, which is greater than 3 0, the arbitrarily accepted standard of a true difference That is, the data show a true increase in duration of presleep with increasing age

Table 3 summarizes the data on mean duration of presleep of other studies and the present study It is impossible to make an exact comparison, since the other studies measured from the time individual children were in bed However, the means given by other studies are all slightly higher than the mean in the present study

Sherman (12) found that the more time the child spent going to sleep, the less time he spent in actual sleep. Aside from the present study, the only one to give data on presleep in relation to age is that of Reynolds (9) Both studies show an increase in presleep with increasing age.

It may be helpful to nursery-school teachers to know that older children tend to take longer in going to sleep, to parents who expect a child to go to sleep as soon as he is put to bed, it may be helpful to know that even younger children tend to have a preliminary period of wakefulness, and that this period increases with age.

3 *Seasonal Variations in Duration of Afternoon Sleep and Presleep*

To determine whether there were seasonal variations in the duration of afternoon sleep and presleep, data for the three years were analyzed separately. September to December, inclusive, were considered as fall months, January to March (which is a month of cold and changeable weather in the Detroit region), as winter months; and April to June as spring months. Data for this study of seasonal variations were selected in order to have the same number of cases throughout the year, and only children who were present during all three seasons and for more than 10 days in each season were included in the study A total of 8,428 records were examined—2,508 for 1934-35, 2,965 for 1935-36, and 2,955 for 1936-

37. The mean and standard deviations for each season were computed from the undistributed raw scores. The findings are shown in Table 5.

TABLE 5
DURATION OF AFTERNOON SLEEP IN FALL, WINTER, AND SPRING DURING THREE SCHOOL YEARS

Season	No. of days	*N*	Duration of sleep Range (minutes)	Mean (minutes)	*SD* (minutes)
			1934-1935		
Fall	61	24	51.9-88.2	71.4	9.8
Winter	57	24	35.0-83.0	65.3	12.9
Spring	45	24	43.3-97.3	71.5	14.0
			1935-1936		
Fall	66	23	63.3-106.8	74.9	9.4
Winter	57	23	55.0-103.1	71.9	12.0
Spring	52	23	59.5-103.0	73.3	9.6
			1936-1937		
Fall	68	25	39.5-94.9	76.4	11.4
Winter	55	25	55.0-89.6	74.1	9.3
Spring	45	25	40.0-89.7	69.4	12.2

In 1934-35 the standard error of the mean for fall was 2.1, for winter, 2.6, for spring, 2.9. The difference in the mean for fall and for winter was 6.1, the standard error of the difference was 3.34, with a critical ratio of 1.8. The chances are 96 in 100 that this is a significant difference. The difference in the mean for winter and for spring was 6.2, the standard error of the difference was 3.88, with a critical ratio of 1.6. The chances are 94 in 100 that this is a significant difference. The difference in the mean for fall and for spring was .10, the standard error of the difference was 3.53, with a critical ratio of .05. The chances are only 52 in 100 that this is a significant difference. That is, in the year 1934-35 there were no significant seasonal variations in the duration of afternoon sleep.

In 1935-36 the standard error of the mean for fall was 2.0, for winter, 2.5, for spring, 2.1. The difference in the mean for fall and for winter was 3.0; the standard error of the difference was 3.15, with a critical ratio of .95. The chances are 83 in 100 that this is a significant difference. The difference in the mean for winter and for spring was 1.4, the standard error of the difference was 3.23, with critical ratio of .41. The chances are 65 in 100 that this is a significant difference. The difference in the mean for fall and spring was 1.6; the standard error of the difference was 2.87, with a critical ratio of .57. The chances are 72 in 100 that this is a significant difference. That is, in the year 1935-36 there were no significant seasonal variations in the duration of afternoon sleep.

In 1936-37 the standard error of the mean for fall was 2.3; for winter, 1.9; for spring, 2.4. The difference in the mean for fall and for winter was 2.3; the standard error of the difference was 2.96, with a critical ratio of .80. The chances are 79 in 100 that this is a significant difference. The difference in the mean for winter and for spring was 4.7, the standard error of the difference was 3.09, with a critical ratio of 1.5. The chances are 93 in 100 that this is a significant difference. The difference in the mean for fall and for spring was 7.0, the standard error of the difference was 3.33, with a critical ratio of 2.1. The chances are 98 in 100 that this is a significant difference. That is, in 1936-37 there were no significant seasonal variations in the duration of afternoon sleep.

If the data for 1934-35 alone had been studied, it might have appeared that children tend to sleep less in the afternoon in winter. However, the critical ratios are all below 3.0, the accepted standard showing a true difference. If 1935-36 had been the only year studied, the conclusion would be that there are no seasonal variations in afternoon sleep. If 1936-37 had been the only year studied, it might appear that children tend to sleep slightly less in the afternoon in spring. Here too, however, the critical ratios are all below 3.0. Taken together, the data show only negligible differences in afternoon sleep from one season to another. The study offers no means of determining whether there are seasonal variations in the total duration of sleep, or of corroborating such studies as that of Renshaw, Miller, and Marquis (8), who found seasonal variations in the sleep of school children aged 6 to 18, directly proportional to age.

Some investigators are of the opinion that since chronological age influences the duration of sleep, there will be less sleep in the spring of a given school year, since the children are older then than in the two preceding seasons. However, Staples (13) found only slight seasonal differences, and Chant and Blatz (3) found, on the whole, no seasonal differences. Erwin (4) found the total day and night sleep longest in the fall and winter.

TABLE 6

PERCENTAGE OF CHILDREN WHO WERE PRESENT BUT DID NOT SLEEP IN FALL, WINTER, AND SPRING, DURING THREE SCHOOL YEARS

Season	1934-5 %	1935-6 %	1936-7 %
Fall	18.4	13.6	17.2
Winter	21.2	16.0	25.6
Spring	*19.7*	*16.6*	21.8

Table 6 shows the percentages of children present but not sleeping in the afternoon at school for the three seasons in each of the three years. They show only slight seasonal differences.

The same records were analyzed to determine whether there were seasonal variations in presleep. The data are shown in Table 7. The means and standard deviations for each group were computed from the undistributed raw scores.

TABLE 7

DURATION OF AFTERNOON PRESLEEP IN FALL, WINTER, AND SPRING DURING THREE SCHOOL YEARS

			Duration of presleep		
Season	No. of days	*N*	Range (minutes)	Mean (minutes)	*SD* (minutes)
			1934-1935		
Fall	61	24	16.2-54.3	34.1	9.1
Winter	57	24	12.4-67.5	35.2	12.8
Spring	45	24	15.2-57.2	32.5	14.2
			1935-1936		
Fall	66	23	11.8-46.9	26.8	10.1
Winter	57	23	9.3-50.0	28.1	11.0
Spring	52	23	11.5-49.5	26.5	10.5
			1936-1937		
Fall	68	25	15.5-95.0	32.9	15.6
Winter	55	25	17.5-50.7	31.5	8.2
Spring	45	25	22.7-92.5	40.8	14.2

In 1934-35, the standard error of the mean for fall was 1.9, for winter, 2.6; for spring, 2.9. The difference in the mean for fall and for winter was 1.1, the standard error of the difference was 3.2, with a critical ratio of only .35. The chances are 64 in 100 that this is a significant difference. The difference in the mean for winter and for spring was 2.7, the standard error of the difference was 3.9, with a critical ratio of 71 The chances are 76 in 100 that this is a significant difference The difference in the mean for fall and for spring was 1.6, the standard error of the difference was 3.4, with a critical ratio of 48. The chances are 68 in 100 that this is a significant difference. That is, there were no seasonal variations in afternoon presleep in this year.

In 1935-36, the standard error of the mean for fall was 2.1, for winter, 2.3, for spring, 2.3. The difference in the mean for fall and for winter was 1.3, the standard error of the difference was 3.1, with a critical ratio of 41. The chances are 65 in 100 that this is a significant difference. The difference in the mean for winter and for spring was 1.6, the standard error of the difference was 3.2, with a critical ratio of .47 The chances are 68 in 100 that this is a significant difference The difference in the mean for fall and for spring was .30, the standard error of the difference was 3.1, with a critical ratio of only .08 The chances are 53 in 100 that this is a true difference That is, there were no seasonal variations in afternoon presleep in this year

In 1936-37, the standard error of the mean for fall was 3.1; for winter, 1.7; for spring, 2.8 The difference in the mean for fall and for winter was 1.4, the standard error of the difference was 3.5, with a critical ratio of .39. The chances are 65 in 100 that this is a significant difference The difference in the mean for winter and for spring was 9.3; the standard error of the difference was 3.3, with a critical ratio of 2.8 The chances are 99.74 in 100 that this is a significant difference The difference between the mean for the fall and for spring was 7.9, the standard error of the difference was 4.2, with a critical ratio of 1.8 The chances are 96 in 100 that this is a significant difference This year, accordingly, shows slight seasonal variations in the amount of afternoon presleep

The separate analyses of the data for the three years show no seasonal variations for two years They do show a lower mean in minutes of presleep in 1935-36 for all three seasons than in the other two years Since the data show longer presleep in the spring of one year only, it seems likely that there are little or no significant seasonal variations in afternoon presleep

4. *Duration of Afternoon Sleep and Presleep on Different Days of the Week*

Investigators have been interested in the question of whether children sleep longer on one day of the school week than on others. Chant and Blatz (3) found that there was less afternoon sleep on Mondays than on other school days. Scott (11) found the average length of the nap to be only one minute less on Friday than on other days of the week. Some nursery-school teachers are of the opinion that the five-day school week accounts for the fact that some individual children sleep much longer on one day of the week; that is, children tired from week-end activities may sleep much longer on Monday, others think that children may sleep longer on Friday, when they have become accustomed to the weekly routine of the nursery school.

In the present study the data for Mondays and Fridays, the first and last days of the school week, were analyzed for variation in the amount of afternoon sleep and presleep. The data for the three years were analyzed separately. After omitting the records of a few children who seldom slept in the afternoon and those of children who were absent on Monday or Friday of the same week, a total of 2832 records were available—749 for 1934-35, 1114 for 1935-36, and 969 for 1936-37. The mean duration of sleep on Mondays and Fridays was determined for each child. The mean and standard deviation for each year were determined by the standard formula applying to measures in a frequency distribution. The results are shown in Table 8.

TABLE 8

DURATION OF AFTERNOON SLEEP ON MONDAYS AND FRIDAYS DURING THREE SCHOOL YEARS

		Duration of sleep					
		Range (minutes)		Mean (minutes)		*SD* (minutes)	
Year	*N*	Monday	Friday	Monday	Friday	Monday	Friday
1934-35	36	51.0-106.2	37.5-101.0	72.6	72.4	11.5	12.7
1935-36	38	55.0-112.1	55.0-101.1	74.4	72.9	11.3	9.1
1936-37	36	52.9- 98.8	46.3- 95.8	76.2	73.9	11.1	11.4

In 1934-35 the standard error of the mean for Mondays was 1.9; for Fridays, 2.1, the difference was .20, the standard error of the difference 2.83, with a critical ratio of .04. The chances are 52 in 100 that this is a significant difference. In 1935-36 the standard error of the mean for Mondays was 1.8; for Fridays, 1.5; the difference was 1.5, the standard error of the difference 2.33, with a critical ratio of .62 The chances are 73.5 in 100 that this is a significant difference. In 1936-37 the standard error of the mean for Mondays was 1.8, for Fridays, 1.9. The difference was 2.3, the standard error of the difference 2.64, with a critical ratio of .84. The chances are 80 in 100 that this is a significant difference. Accordingly, the data for the three years show no significant differences in duration of afternoon sleep on Mondays and Fridays.

The same records and methods were used to ascertain whether there was a difference in duration of afternoon presleep on Mondays and Fridays The results are shown in Table 9

TABLE 9

DURATION OF AFTERNOON PRESLEEP ON MONDAYS AND FRIDAYS DURING THREE SCHOOL YEARS

		Duration of presleep					
		Range (minutes)		Mean (minutes)		*SD* (minutes)	
Year	*N*	Monday	Friday	Monday	Friday	Monday	Friday
1934-35	36	11.0-58.3	7.0-57.0	32.0	32.7	10.5	12.6
1935-36	38	8.3-60.0	7.7-55.0	27.0	24.9	11.6	10.2
1936-37	36	18.4-57.5	19.1-66.8	31.5	34.1	9.0	10.4

In 1934-35 the standard error of the mean for Mondays was 1.8; for Fridays, 2.1; the difference in the means was .70, the standard error of the difference 2.72, with a critical ratio of .25. The chances are 60 in 100 that this is a significant difference In 1935-36 the standard error of the mean for Mondays was 1.9, for Fridays, 1.6. The difference in the means was 2.1, the standard error of the difference 2.48, with a critical ratio of .86 The chances are 80 in 100 that this is a significant difference In 1936-37 the standard error of the mean for Mondays was 1.5, for Fridays, 1.7 The difference between the means was 2.6, the standard error of the difference 2.28, with a critical ratio of 1.15 The chances are 87 in 100 that this is a significant difference. Accordingly, the present study shows no significant difference in duration of afternoon presleep on Mondays and Fridays.

5 *Effect upon Afternoon Sleep of the Number of Children in the Room*

Chant and Blatz (3) found that the number of children in the room did not interfere with the sleep of children who had acquired good sleeping habits, nor did the percentage of those who slept vary much with the number present Reynolds and Mallay (10) found that children took as long to go to sleep when alone in a room as when they were in a room with several other children, and that they slept only eight minutes longer when in individual rooms.

In the present study, data for the three years were analyzed separately The number of children present on any one day of the three years varied from 5 to 32, and the number of children who slept varied from 3 to 28 The Pearson product-moment formula was used in determining the correlation between the number of children present and the percentage who slept Table 10 shows the results The correlations are too low to be considered significant The findings accordingly substantiate those of others in showing the number of children present in the room to have little effect upon the afternoon sleep of children.

TABLE 10

CORRELATION BETWEEN THE PERCENTAGE OF CHILDREN WHO SLEPT IN THE AFTERNOON AND THE NUMBER OF CHILDREN IN THE ROOM

Year	Correlation (Pearson product-moment)
1934-35	139± 0562
1935-36	065± 0290
1936-37	099± 0513

The results should be of interest to those who have questioned the desirability of putting many children in one room for afternoon sleep Parents enrolling children in nursery school sometimes question whether they will sleep as well as they do at home, for nursery schools also the question is important, since they often have only one room available for this purpose It appears, however, from the results of this study, as well as others, that the number of children present in the room is not an influencing factor in the afternoon sleep of the child

6 *The Comparative Duration of Sleep and Presleep in a Selected Group and in the Entire Group*

The duration of sleep and presleep in a group of 10 children enrolled in all three age groups during the three-year period was compared with the duration of sleep and presleep in the entire group

TABLE 11

COMPARATIVE MEAN DURATION OF AFTERNOON SLEEP AND PRESLEEP IN SELECTED GROUP OF TEN CHILDREN AND IN ENTIRE GROUP

Age group	Mean duration of sleep Group	Mean duration of sleep Ten children	Mean duration of presleep Group	Mean duration of presleep Ten children
Two-year	77.3	75.2	24.4	25.5
Three-year	74.7	76.7	31.0	25.8
Four-year	69.1	71.7	34.8	33.6

TABLE 12

DURATION OF AFTERNOON SLEEP AND PERCENTAGE OF DAYS PRESENT THAT CHILD DID NOT SLEEP FOR GROUP OF TEN CHILDREN

Child	Total No. days present	No. days child did not sleep	Per cent days child did not sleep	Mean duration of sleep (minutes)	*SD* (minutes)
		Two-year group			
B-6	43	1	2.3	106.8	15.8
F-3	36	0		74.6	12.2
G-4	33	3	9.1	81.5	13.6
H-2	58	0		76.9	14.9
H-5	34	0		62.1	9.4
H-7	39	0		86.9	15.0
M-2	12	2	16.7	62.0	18.1
M-7	64	12	18.7	62.0	13.2
M-9	62	0		68.8	12.2
S-6	49	1	2.0	69.9	15.6
		Three-year group			
B-6	145	1	0.4	99.6	20.9
F-3	130	0		82.2	15.4
G-4	101	13	12.9	79.3	13.9
H-2	154	22	14.3	79.6	18.6
H-5	111	1	0.9	73.2	12.9
H-7	128	1	0.8	81.0	15.4
M-2	103	0		56.8	13.9
M-7	94	32	34.0	62.7	10.2
M-9	114	7	6.1	71.1	14.5
S-6	83	1	1.2	81.5	15.1
		Four-year group			
B-6	77	15	19.5	89.7	18.8
F-3	134	7	5.2	76.9	15.3
G-4	157	115	73.2	70.7	11.9
H-2	50	25	50.0	55.8	17.5
H-5	102	0		74.9	10.7
H-7	152	53	34.9	76.5	19.1
M-2	150	4	2.7	62.9	13.8
M-7	98	82	83.7	67.5	8.9
M-9	130	90	69.2	64.4	14.7
S-6	96	1	1.0	77.3	15.5

Since none of the children entered before the age of two and a half years, the total number of days for which data were available was less for the two-year group.

The results are shown in Table 11. The number of cases is too small to permit a satisfactory comparison of the two groups. However, as given, the figures tend to be similar for the two groups, and suggest that it may be possible to get the same results from the study of a small group of children over a longer period of time as from a large group.

The percentage of those who did not sleep in the afternoon was also similar in the two groups. The comparative figures for the percentage of days when some children did not sleep was 4.0 for the entire group, 4.4 for the selected group, for the two-year-olds, 9.9 and 6.7 for the three-year-olds; and 29 and 34.2 for the four-year-olds.

Table 12 shows in detail the duration of afternoon sleep and the percentage of days present when sleep was not taken, for the selected group of 10 children. The data show wide individual differences in the number of days when sleep was not taken. In six children duration of sleep did not decrease with increase in age, even in the fourth year of age, several of the children slept in the afternoon almost every day they were at school. Table 13 shows the duration of presleep in the selected group of 10 children. Both tables show wide individual variations among children in afternoon sleep and presleep, and suggest the importance of considering the needs of the individual child in this respect.

TABLE 13

DURATION OF PRESLEEP OF SELECTED GROUP OF TEN CHILDREN

	Duration of presleep					
	Two-year group		Three-year group		Four-year group	
Child	Mean (minutes)	SD	Mean (minutes)	SD	Mean (minutes)	SD
B-6	21.9	13.2	22.9	13.0	33.8	15.1
F-3	24.7	16.6	22.5	11.6	33.5	14.5
G-4	26.4	15.1	34.1	15.8	42.0	11.9
H-2	11.1	8.2	23.7	18.2	40.8	15.8
H-5	27.9	11.4	21.8	12.2	14.8	6.2
H-7	17.3	10.8	22.7	12.1	40.3	15.4
M-2	33.0	20.1	21.8	11.4	20.1	13.2
M-7	31.3	15.4	35.6	20.4	40.0	10.9
M-9	28.0	12.3	33.6	13.9	48.1	14.4
S-6	33.3	21.3	19.1	19.1	22.1	11.3

D Summary of Findings

1. Evidence was found of a slight but true decrease in duration of afternoon sleep with increase in age

2 Evidence was found of a slight but true increase in duration of afternoon presleep with increase in age.

3 Further evidence was found that afternoon sleep tends to drop out with increase in age

4. Seasonal differences in the duration of afternoon sleep and presleep were found to be negligible.

5 No significant differences were found in duration of afternoon sleep and presleep on Mondays and Fridays

6. No evidence was found that the number of children in the room was an influencing factor upon the number of children who slept.

7 Wide individual differences were found in the duration of afternoon sleep and presleep

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The Journal of Genetic Psychology, 1941, 58, 181-199

CHILDREN'S THINKING ABOUT NATIONS AND RACES*[1]

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A. Introduction

Of marked significance in present-day social disharmony are the race and nationality attitudes of people[2] Of particular importance educationally are the concepts and attitudes the school children are developing What children think about nations and races is important, first, because it is indicative of adult beliefs which influence their thinking Of even greater social significance is the fact that the notions and attitudes children obtain in their early years they all too often hang on to as adults In the words of Havelock Ellis, "It is in youth that the questions of mature age can alone be settled, if they ever are to be settled, and unless we begin to think about adult problems when we are young, all thinking is likely to be in vain"(4)

In his very comprehensive study of minority peoples in the United States, Donald Young expresses the opinion that "not a single individual in the United States is permitted by his own beliefs and by the controlling attitudes of his group to regard his fellows as individuals rather than as members of some class or caste based on racial or national ancestry, and characterized thereby" (18) These attitudes, he adds, "affect beliefs in inborn qualities, limit employment, fix the place of residence, influence forms of recreation, and go so far as to prescribe permissible varieties of social relationships"

The present study is one of a series concerned with the development of nationality and race attitudes of American children In

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*Received in the Editorial Office on December 6, 1939

[1] Paper presented before Midwestern Psychological Association meetings of 1939 in Lincoln, Neb For help in working up the material, the writer is greatly indebted to his secretary, Mrs Ruth Havemann

[2] Because in this investigation we are interested in a study of actual people and the way they think, the words "nations" and "races" are used roughly as the average man in everyday life uses them, this means a lumping and at times a confusing of factors which are biological, cultural, and political

previous studies we have reported the group preferences in nationality and race attitudes, indicating the effects of religious, economic, and race differences on the nationality preferences of children (11) In a second study we have reported the preferences and stereotypes of one minority group, a group of colored children (12) In a third study we reported the results of an investigation of changes that have taken place in the attitudes of children toward peaceful and warlike nations between 1934 and 1938 (9). In the present study it is planned to investigate the nature of children's concepts for the purpose of throwing light on the following questions concerning children's thinking about nations and races (*a*) What do children think about the nations and races studied? (*b*) What is the extent of stereotypy that appears in children's thinking about nations and races? That is, to what extent is there a concentration in their reasons and convergence of judgment for believing as they do? (*c*) Why do children feel as they do about these nations? What reasons do they give for liking, disliking or being indifferent to them? (*d*) What do the concepts signify as cues or sets for social interaction in the American scene? To what extent, that is, do they signify favorable possibilities for friendly interaction, or, on the other hand, to what extent do they signify hostile interaction relations?

B THE CHILDREN EXAMINED

In 1934 we investigated the nationality attitudes of 2422 St Louis school children The findings in the present investigation are based on a study of 990 children selected from this 1934 group and an additional 330 children examined in 1938 to permit the effects of recent world events to register in children's reporting of their notions

Of the 990 subjects examined in 1934, roughly 18 per cent are taken from a rich school district, 64 per cent from two schools in a middle class district, and 18 per cent from a school in a lower class district Of the 1938 group, approximately 58 per cent were taken from a school in a district that is dominantly middle class but also has some incoming poor and some outgoing rich in the total population, and 42 per cent from schools in relatively poorer districts The total population examined, then, is composed of 1320 children, 13 per cent of whom come from a relatively rich district, 62 per cent from middle class districts, and 25 per cent from relatively poor districts. This is not exactly a perfect sampling of the St. Louis population, considered from the point of view of economic background, but it is not far from it. The children examined were selected from the fifth grade through the eighth grade, inclusive, with approximately the same number from each grade, and range in age from nine to 16.

C. PROCEDURE

The instructions printed on top of the mimeographed sheet filled out by each child read as follows: *"Place a check mark in the one square of each line which best describes your feeling toward the nation or race listed on the left."* These instructions were followed by a list of 21 nationalities on the left side of the sheet. On the right of each nationality were arranged spaces for checking the degree of feeling. The nationalities and races listed were American, Armenian, Chinese, Englishman, Frenchman, German, Greek, Hindu, Irishman, Italian, Japanese, Jew, Mexican, Negro, Pole, Russian, Scotchman, Spaniard, South American, Swede, and Turk. The range of intensity of feeling included intense like, like, neutral, dislike, intense dislike. When finished checking their degrees of feeling, the children were instructed to read with the examiner the directions at the bottom of the sheet, which were *"Why did you mark the above as you did? In the blank spaces at the right, write your reason for each selection."* Space for writing out these reasons was arranged to the right of the space allowed for checking feelings. It is these reasons given by the children for the feelings they expressed which form the source materials of the present investigation. The examiner in each classroom illustrated on the blackboard the way to fill out the sheets. To further assure the understanding of directions by the children they were instructed to raise their hands if in doubt, and in all instances the examiner answered each question of every child who signified a need.[3] The ways of treating the materials, including the nature of classifications used, will be described along with the specific findings of the problems as considered

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[3] For cooperation in making the subjects available and the examination of them possible, the writer wishes to express his thanks to all the children examined, their teachers, their principals, and their administrators in the St. Louis school system. Particularly is he indebted to Dr. Henry Gerling, Superintendent of St. Louis Schools, George R. Johnson, Director of Tests and Measurements, Miss Jennie Wahlert, and Miss Mary A. Thompson.

D Findings

1 *What Children Think About 21 Nations and Races*

Relatively few of the nationality and race preference studies have investigated the notions or concepts the subjects have. Bialy and Katz (5), in their study of the racial stereotypes of 100 college students, had their subjects check a list of traits for describing each of 10 groups studied. In their study they report the 12 traits checked for each of the 10 groups. Stereotypy they indicate by reporting the least number of traits which must be taken to include 50 per cent of the possible assignment for each group. Zeligs (19), in her study of race concepts of 200 sixth grade children, reports only the single most common concept given by the children to each of 38 nations and races studied. Illustrative examples of concepts given for favorable, neutral, and unfavorable reactions to Americans, Jews, and Negroes are also included by her. No quantitative treatment of the data is made by this investigator. The method used in the present study is proposed to yield the advantage of the naturalness and spontaneity obtained by Zeligs, who had the children give their own notions rather than check a list given to them by the investigator, and also the advantage of more quantitative treatment of the results made by Katz and Bialy in their study of stereotypes.

In Table 1 are presented the six most common notions given by the children studied of each nation or race. The number of mentions and the per cent of the total reasons are indicated in each instance. Where "Don't know" or "No good reason" or similar non-content answers rate among the first six most frequently given another content answer is added.

In the original data we have tabulated separately the frequency of mentions for the 1934 population as well as the 1938 population. Generally speaking, the concepts of the various nations and races given by the children in 1934 parallel those given in 1938. The largest differences appear in their greatly increased awareness of peace and war attitudes of nations, and this has already been reported in detail in a previous study (9).

Related to this increased awareness of peaceful and warlike tendencies in nations are some concepts which appear in 1938 but not in 1934. Outstanding is increased thinking about America in terms of its being a land of comparative freedom, a land which has re-

TABLE 1

THE MOST COMMON RACE AND NATIONALITY NOTIONS OF AMERICAN CHILDREN

Nation or race	Most common notions for each nation	Number of mentions	Per cent
American	I am an American! it's my nation	954	72.27
	Good, nice, kind	92	6.97
	They are my friends, acquaintances	57	4.32
	I like them	39	2.95
	Honest, fair and square	20	1.52
	Peaceful	18	1.36
Armenian	Not acquainted, don't know much about them	796	60.30
	Don't know, no good reason	69	5.23
	Good, nice, kind	51	3.86
	Neutral, don't like or dislike	46	3.48
	I like them	19	1.44
	Nothing against them	17	1.29
	They are my friends, acquaintances	16	1.21
Chinese	Not acquainted, don't know much about them	291	22.05
	Good, nice, kind	83	6.29
	They are my friends, acquaintances	57	4.32
	Their ways	47	3.56
	Neutral, don't like or dislike	47	3.56
	Sly, sneaky, crafty	40	3.03
	Don't know, no good reason	38	2.88
	Peace-loving	36	2.73
	I don't like them	36	2.73
Englishman	They're much like us	186	14.09
	Good, nice, kind	160	12.12
	I am of English descent	123	9.32
	Not acquainted, don't know much about them	123	9.32
	They are my friends, acquaintances	100	7.58
	Our forefathers, our mother country	82	6.21
	Their speech, accent	63	4.77
Frenchman	Not acquainted, don't know much about them	232	17.58
	Good, nice, kind	181	13.71
	They are my friends, acquaintances	89	6.74
	I am of French descent	72	5.45
	Helped us in war, our allies	71	5.38
	Their speech, accent	59	4.47
	I like them	51	3.86
	Don't know, no good reason	46	3.48
	Friend of America	31	2.35

TABLE 1 (continued)

Nation or race	Most common notions for each nation	Number of mentions	Per cent
German	I am of German descent	256	19.55
	Good, nice, kind	142	10.76
	They are my friends, acquaintances	122	9.24
	Not acquainted, don't know much about them	113	8.55
	Had war with us, fought against us	54	4.09
	Their treatment of the Jews	50	3.79
	War-loving	47	3.56
Greek	Not acquainted, don't know much about them	404	30.61
	They are my friends, acquaintances	107	8.11
	Good, nice, kind	85	6.44
	Don't know, no good reason	55	4.17
	Neutral, don't like or dislike	44	3.33
	I don't like them	41	3.11
	I am of Greek descent	35	2.65
	Their ways	35	2.65
Hindu	Not acquainted, don't know much about them	536	40.61
	Don't know; no good reason	88	6.67
	I don't like them	46	3.48
	Magic, tricks, mystery	42	3.18
	Their ways	40	3.03
	Neutral, don't like or dislike	38	2.88
	Good, nice, kind	30	2.27
Irishman	I am of Irish descent	257	19.47
	Good, nice, kind	182	13.79
	Not acquainted, don't know much about them	158	11.97
	They are my friends, acquaintances	138	10.46
	Gay, jolly	81	6.14
	Don't know, no good reason	48	3.64
	I like them	39	2.95
	Friendly	33	2.50
Italian	Not acquainted, don't know much about them	231	17.50
	They are my friends, acquaintances	167	12.65
	Good, nice, kind	132	10.00
	I am of Italian descent	61	4.62
	Neutral; don't like or dislike	54	4.09
	Don't know, no good reason	54	4.09
	I like them	40	3.03
	Their ways	38	2.88

TABLE 1 (continued)

Nation or race	Most common notions for each nation	Number of mentions	Per cent
Japanese	Not acquainted, don't know much about them	297	22.50
	War-loving, like to fight	105	7.95
	War on China; treatment of China	89	6.74
	Neutral, don't like or dislike	49	3.71
	Their ways	47	3.56
	Good, nice, kind	47	3.56
	Don't know, no good reason	43	3.26
	I don't like them	38	2.88
	They are my friends, acquaintances	34	2.58
Jew	Not acquainted, don't know much about them	167	12.65
	They are my friends, acquaintances	146	11.06
	I am a Jew	123	9.32
	Good, nice, kind	101	7.65
	I don't like them	59	4.47
	Cheaters, gyppers	44	3.33
	Don't know, no good reason	44	3.33
	Neutral, don't like or dislike	40	3.03
	Their ways	37	2.80
Mexican	Not acquainted, don't know much about them	323	24.47
	Good, nice, kind	96	7.27
	They are my friends, acquaintances	76	5.75
	Don't know, no good reason	67	5.08
	Neutral, don't like or dislike	50	3.79
	Their ways	40	3.03
	Our neighbors, live on the same continent	36	2.73
Negro	Good, nice, kind	147	11.14
	Not acquainted, don't know much about them	136	10.30
	They're not like us	107	8.11
	They are my friends, acquaintances	86	6.52
	Dirty	68	5.15
	Don't know, no good reason	61	4.62
	Neutral, don't like or dislike	56	4.24
	I don't like them	49	3.71
	Industrious, good workers	49	3.71
Pole	Not acquainted, don't know much about them	544	41.21
	Don't know, no good reason	95	7.20
	Good, nice, kind	91	6.89
	They are my friends, acquaintances	55	4.17
	Neutral, don't like or dislike	40	3.03
	I am of Polish descent	36	2.73
	Their ways	22	1.67

TABLE 1 (continued)

Nation or race	Most common notions for each nation	Number of mentions	Per cent
Russian	Not acquainted, don't know much about them	417	31.59
	Good, nice, kind	93	7.05
	Don't know; no good reason	86	6.52
	They are my friends, acquaintances	49	3.71
	Neutral, don't like or dislike	43	3.26
	I am of Russian descent	41	3.11
	Their ways	33	2.50
Scotchman	Not acquainted, don't know much about them	262	19.85
	Stingy, tight	112	8.48
	Good, nice, kind	112	8.48
	I am of Scotch descent	84	6.36
	They are my friends, acquaintances	80	6.06
	Don't know, no good reason	65	4.92
	Thrifty	48	3.64
Spaniard	Not acquainted, don't know much about them	327	24.77
	Good, nice, kind	106	8.03
	Don't know, no good reason	80	6.06
	They are my friends, acquaintances	63	4.77
	I like them	47	3.56
	Neutral; no good reason	44	3.33
	Their dancing, good dancers	38	2.88
South American	Not acquainted, don't know much about them	425	32.20
	Good, nice, kind	95	7.20
	Don't know, no good reason	84	6.36
	I like them	49	3.71
	Neutral, don't like or dislike	48	3.64
	Our neighbors; live on the same continent	46	3.48
	They're much like us	42	3.18
	I've read about them, studied about them	42	3.18
Swede	Not acquainted, don't know much about them	391	29.62
	Good, nice, kind	147	11.14
	Don't know; no good reason	93	7.05
	They are my friends, acquaintances	65	4.92
	I like them	36	2.73
	Neutral; don't like or dislike	33	2.50
	I am of Swedish descent	32	2.42
	Peace-loving	32	2.42
Turk	Not acquainted, don't know much about them	495	37.50
	Don't know, no good reason	102	7.73
	Mean, cruel	60	4.55
	Good, nice, kind	47	3.56
	I don't like them	46	3.48
	Neutral; don't like or dislike	44	3.33
	War-loving	28	2.12

ligious freedom, freedom of speech There were nine such mentions in 1938 and none in 1934 Other reasons for expressed feelings toward Americans are they are educated, advanced and modern; loyal, faithful; all for one, one for all, mind their own business, industrious, don't think they're better than anyone else, have made a great nation out of nothing, whenever they fight, they fight for freedom, brave, self-reliant Only one child expressed a dislike for Americans, calling them two-faced and dishonest [1]

The children's notions of the Chinese have changed fairly much between 1934 and 1938 "Sly, sneaky, crafty" appears as one of the six most frequently mentioned notions because of its frequent mention in 1934 In 1938 the children more often think of the Chinese as being faithful, friends of America, oppressed, advanced, and of China as a nation that deserves pity and that fights for its rights and is defending itself against Japan Some notions expressed in 1934 again appear in 1938, such as the Chinese are uncivilized and backward.

Children's notions of the English, other than those included in the most frequently given, referred to their sportsmanship, their being civilized and modern, industrious, honest, fair, and square More specific responses toward the behavior of the English government appear in 1938 For example, one child describes them as fighting for peace and the Jews in Arabia; another describes them as being full of dirty politics

A number of the children's reactions toward the Frenchmen are influenced by our early history and the fact that France helped us in the Revolutionary War, gave us the Statue of Liberty, and also by the fact that we were on their side in the World War A number of references also appear to the fact that the French have beautiful architecture, art work, and cathedrals

The most obvious change in the children's reactions toward Germans is that there is a dropping off of such qualities as gay and jolly, industrious, intelligent and friendly, which got anywhere from 10 to 15 mentions in 1934 and only two or three mentions in 1938 In the 1938 responses of the children there is a substantial increase in thinking of Germany as being a trouble maker, a persecutor of people, a nation that may cause a world war, and unfavorable references to Hitler

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[1] For a complete profile of this child's nationality preferences see (9)

Though the children know relatively little about the Hindus, they do think of them rather often, more so than they do of other nations, in terms of religion In their reactions to the Irish, aside from thinking of them in terms of being gay and jolly very often, so that it rates among the first six reasons, they also think of them as being good fighters, who fight for their rights and have hot tempers. In reaction to the Italians, the children as a whole seem to know not too much about them. Twenty-five children thought of the Italians in terms of their food and cooking, mostly favorable, and 19 in terms of their music and singing. In 1934 there were 23 children who thought of the Italians as being friendly, but there were only four such responses in 1938

Reasons, other than the first six or seven given, for liking the Jews are that Jesus was one, they are religious, intelligent and smart, gay and jolly, honest, peaceful. Reasons for disliking them include· they are stingy, because of their religion, are not Christian, crucified Christ, don't mind their own business, try to run our country, are not friends of America. Notions other than those listed in Table 1 for the Mexicans are they are interesting, like their dress, they are much like us, are mean, sly and sneaky, dirty, have good music and singing Reasons other than the most frequently given for liking the Negro include they are as good as we are, are friendly, industrious, gay and jolly; are treated badly. Reasons for disliking them include they take advantage of the whites, rob, steal and commit crimes; are mean, treacherous, and should have stayed in Africa

Of the Poles the children in general know relatively little Their notions, other than those listed in Table 1, include. industrious, peaceful, dirty, mean, friendly. Frequently mentioned notions about the Russians referred to their dancing, music and singing, and dress Communism was given as a reason for disliking them more often in 1934 than in 1938 In 1938, the Russians were thought of more frequently as people who were trying to build up their country and improve themselves.

Aside from the most frequently given notions, the Scotch are most often thought of as intelligent, gay and jolly, honest, industrious, and having fine music. The Spaniards are frequently thought of with reference to their music, dress, their bullfights, and explorations South Americans are thought of as industrious, uncivilized, mean, dangerous, friendly, polite and refined, and as a friend of America. Some frequently mentioned notions concerning the Swedes include they are industrious, mind their own business, are strong and healthy, friendly, civilized, and advanced The Turks are most frequently described as being dangerous, savage, and uncivilized There are also numerous references to their religion and to their wars with Christians.

2 *Stereotypy in Children's Concepts of Nations and Races*

That our children's race concepts tend to be stereotypes—pictures in the head—in the sense in which Lippman[5] first analyzed their influence in the formation of public opinion can easily be observed from the data reported in Table 1 A more concise picture of the extent of stereotypy in reasons given can be obtained from the data reported in Table 2 Here is reported the convergence of judgment as indicated by the concentration of answers found in the reactions of the children to each nation or race Concentration or convergence is reported in terms of percentage of the total number of possibilities for the first six most common notions The columns are presented in reverse order; the total per cent for the first six notions appears in the first column, and the per cent of the most frequently mentioned appears in the last column

A glance at the foregoing table indicates a fair amount of stereotypy in children's thinking about all nations and races. Stereotypy considered in terms of concentration of answers is generally the result of the children having one or relatively few fixed notions that appear over and over again. In a few instances concentration is reenforced by the children's ignorance about the nation Responses to America illustrate the former, reactions to Armenia, the latter In all but three of the nations and races listed, the first six most frequent notions include more than 50 per cent of the total number of responses The three are the Chinese, the Negro, and the Jew, and the first seven most frequent mentions in all instances pass the 50 per cent mark The first two mentions hit the 50 per cent zone for the Hindu in 1938, the first three in 1934 The first three

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[5] For a discussion of the meaning of stereotypes the reader is referred to Walter Lippman's *Public Opinion* (8), Stuart Rice's *Quantitative Methods in Politics* (16), and Meltzer's "Personification of Ideals and Stereotypes in Problem Children" (13)

TABLE 2

STEREOTYPY IN CHILDREN'S CONCEPTS OF NATIONS AND RACES

Nation or race		Total of 1st 6	Total of 1st 5	Total of 1st 4	Total of 1st 3	Total of 1st 2	Total of 1st only
American	1934	91.84	90.63	89.22	85.79	80.94	74.37
	1938	86.67	83.94	81.21	78.48	74.24	66.06
Armenian	1934	77.86	76.15	74.13	70.09	65.75	60.80
	1938	72.12	70.91	69.09	67.27	64.85	58.79
Chinese	1934	46.05	42.41	38.37	34.33	29.79	23.63
	1938	47.27	43.33	39.39	32.72	25.75	17.27
Englishman	1934	62.22	55.55	47.27	38.68	28.98	16.16
	1938	49.69	44.84	38.48	30.60	22.42	12.42
Frenchman	1934	54.25	49.70	44.14	38.08	31.41	16.16
	1938	51.52	47.28	42.73	37.88	30.91	21.82
German	1934	60.51	55.76	50.81	42.73	33.13	21.11
	1938	51.51	47.57	40.60	32.42	24.24	14.24
Greek	1934	56.68	53.04	48.90	44.35	38.59	30.91
	1938	56.96	54.54	51.81	47.57	39.09	29.70
Hindu	1934	60.41	57.48	54.15	50.61	46.06	40.00
	1938	59.99	57.87	55.75	53.63	50.90	42.42
Irishman	1934	65.74	62.41	55.95	45.45	33.53	19.29
	1938	64.87	60.02	54.84	44.54	32.42	20.00
Italian	1934	54.45	50.41	45.97	40.21	29.60	16.77
	1938	52.45	49.42	45.18	40.00	31.82	19.70
Japanese	1934	47.46	43.62	39.48	35.14	30.70	24.64
	1938	57.88	55.46	52.73	50.00	36.36	20.30
Jew	1934	49.79	46.46	41.61	33.53	22.52	11.31
	1938	47.29	43.05	38.81	33.63	27.27	16.36
Mexican	1934	50.91	47.37	43.53	38.58	33.33	25.35
	1938	46.69	43.36	39.72	34.54	29.09	21.82
Negro	1934	46.45	41.60	36.15	29.89	20.50	11.01
	1938	46.36	42.42	38.18	31.82	24.55	13.03
Pole	1934	64.73	61.60	58.47	53.42	46.15	38.78
	1938	66.98	65.46	63.64	60.91	55.15	48.48
Russian	1934	56.27	53.04	49.50	45.86	39.29	32.12
	1938	52.73	50.00	46.97	43.03	36.67	30.00
Scotchman	1934	54.45	49.80	43.64	37.18	28.49	18.79
	1938	53.34	48.49	43.64	37.88	30.91	23.03
Spaniard	1934	51.01	47.78	43.74	39.40	33.34	24.75
	1938	53.05	49.11	43.93	37.87	31.51	24.54
South American	1934	56.97	53.03	47.27	43.23	38.89	30.91
	1938	57.26	54.84	52.42	49.09	44.24	36.06
Swede	1934	60.09	57.46	54.13	48.88	41.61	29.59
	1938	59.70	55.76	51.21	44.85	38.18	29.70
Turk	1934	61.71	58.48	54.84	50.60	45.45	37.98
	1938	58.17	54.84	51.51	48.18	44.54	36.06
Median	1934	56.68	53.04	47.27	42.73	33.34	24.75
	1938	53.34	50.00	46.97	43.03	32.42	23.03
Range	1934	46.05 – 91.84	41.60 – 90.63	36.15 – 89.22	29.89 – 85.79	20.50 – 80.94	11.01 – 74.37
	1938	46.36 – 86.67	42.42 – 83.94	38.18 – 81.21	30.60 – 78.48	22.42 – 74.24	12.42 – 66.06

mentions include 50 per cent or more of all reasons given for expressed feelings toward the Pole in both years They pass the 50 per cent zone for the Turk in 1934, but it takes four mentions to pass that zone in 1938 The Irish and the Swede pass the 50 per cent zone in four mentions in both years The children's reaction to Germany and England is less stereotyped in 1938 than it is in 1934 Whereas in 1934 the 50 per cent zone is passed by the four most frequent mentions, this mark is not passed in 1938 until the first six Reactions to the Japanese, however, show increases in stereotypy in 1938 over 1934 Apparently the events in Europe have made children become more aware of specific situations, particularly in relation to England and Germany, and their responses have therefore become more differentiated toward these two nations. Stereotypy is therefore decreased The degrees of stereotypy in both 1934 and 1938 for the other nations are indicated in the table

3 *Reasons for Children's Feelings About Nations and Races*

From the data thus far presented, it is obvious that children have definite preferences and have reasons for them They have reasons for their like and dislike for and indifference to the various nations studied. To describe all the reasons given by the children for their reactions toward every nation studied would take too much space, because the children give a large variety of reasons for their feelings For example, for their expressed feelings toward a single nation which is generally favored, England, they give 825 reasons for liking, 147 for indifference, and 17 for dislike For their expressed feelings toward one of the least favored nations, Turkey, they give 123 reasons for liking, 547 reasons for indifference, and 365 for disliking The total number of reasons given by all children for liking all nations studied is 10,748, for indifference, 10,741 reasons were given by the children, and for disliking, 4,125 reasons Since in this paper we are interested not only in the specific notions of the children toward each nation but also in the reasons they give for liking any nation or disliking any nation or expressing any feeling toward any nation, by lumping all reasons for expression of a feeling toward all nations we gain some insight into the nature of the children's nationality feelings It is a fact that the number of reasons given by children for their feeling is to some extent determined by their vocabulary or the qualities with which they are familiar, and they will give many of the same reasons for expressing feelings toward many nations. In Table 3 we are giving the 10 most frequently mentioned reasons for liking expressed by the children; the 10 most frequently mentioned reasons for indifference in Table 4; and the 10 most frequently mentioned reasons for disliking in Table 5 These are presented in terms of mention and per cent Other reasons given for each feeling are also indicated, without tabulations, directly following the first ten

TABLE 3

TEN MOST COMMON REASONS FOR LIKING ALL NATIONS OR RACES

Reason	Total	Per cent
Good, nice, kind	1595	14 84
They are my friends, acquaintances	1287	11 97
I am one, it is my nationality	1074	9.99
I am of — descent	1001	9 31
I just like them	626	5 82
They are much like us	311	2.89
They are friendly	297	2 76
I don't know, no good reason	273	2.54
Their ways	266	2 47
Gay, jolly	246	2 29
Total	6976	64.88

(Total number of like mentions—10,748)

TABLE 4

TEN MOST COMMON REASONS FOR INDIFFERENCE TO ALL NATIONS

Reason	Total	Per cent
Not acquainted, don't know much about them	6011	55 96
Neutral; don't like or dislike	817	7 61
Don't know, no good reason	804	7 49
Good, nice, kind	611	5 69
Some are all right, some aren't	238	2 22
Nothing against them	223	2.08
They are my friends, I know some	215	2 00
They aren't like us	150	1 39
Their ways	133	1.24
I've read about them, studied about them	79	0 74
Total	9281	86 42

(Total number of neutral mentions—10,741)

Illustrative of other reasons given for liking nations are· honest, loyal, faithful, friendly, clean, thrifty, intelligent, peaceful, mind

TABLE 5

Ten Most Common Reasons for Disliking All Nations

Reason	Total	Per cent
I don't like them	521	12.63
Not acquainted, don't know much about them	422	10.23
Mean, cruel	282	6.84
War-loving, like to fight	254	6.16
They are not like us	229	5.55
Their ways	200	4.85
Don't know, no good reason	197	4.78
Dirty	169	4.09
Sly, sneaky, crafty	117	2.84
No good, bad	110	2.67
Total	2501	60.64

(Total number of dislike mentions—4,125)

own business, industrious, speech, dress, music and singing, dancing, beautiful country, modern and advanced, skillful, brave, good fighters, interesting, friend of America, trade with us, manufacture many things, polite and refined, are Christian, their food or cooking, their religion, are oppressed, neighbors of the United States, don't cause trouble, generous, good athletes, explorers, inventors, law abiding, art talent and art work, strong and healthy, are easy to get along with, patriotic, philosophical, paid their debt to the United States, are adventurous, persevering, helped us in wars.

Illustrative of other reasons given for indifference to nations are: they can't help their color, it's not their fault they started the World War, some nations yes, others no (with reference to South America), Mussolini—no, some citizens—yes, and like people but not ruler (both with reference to Italy). Aside from the obviously neutral reasons listed above, the majority of reasons given for indifference to nations are duplicates of reasons given for liking and disliking

Illustrative of other reasons given for disliking nations are: unfriendly, appearance, greedy, rude, steal, rob, kill people, stingy, selfish, stupid, have a dictator, are having war, may cause a war, had a war with us, cheaters, dishonest, suspicious, don't mind their own business, stubborn, lazy, have no freedom, want their own way, aren't Christian, too aggressive, their attitude or spirit, drunkards, pick on small nations, uncivilized, backward, don't pay their war debt, fight for land, want to rule the world, because of Hitler and Mussolini, conquest of Ethiopia and Austria, enemy of America

4 *Nationality and Race Attitudes of American Children*

The social significance of an attitude lies in the fact that it represents a "set" or determining tendency for interaction The extent to which American children are set for various styles of interacting adjustments with the 21 nations or races is indicated in Table 6. Categories used for classifying styles of adjustment are first, identification (in group), second, friendly interacting reactions, third, reactions which indicate neutral acceptance, and, fourth, hostile interacting reactions The per cent of "don't know" answers reported in the last column are included here because they also indicate an unpredictable "set" for interaction

A study of the foregoing table indicates that the children, as far as their sets or cues for relations with other children from all nations studied are concerned, have reactions in 1938 that are quite like those in 1934 The only difference is in the larger number of "don't know" answers given in 1938 Roughly, their reactions indicate that they can get along in friendly manner or better with approximately 36 per cent of children from nations studied, can get along with neutral acceptance or better with 49 per cent, and toward approximately 12 per cent have hostile interacting reactions The "don't know" answers are unpredictable in a lump, since they are given chiefly for neutral reactions but also are given for like and dislike reactions

In their friendly interacting reactions, they rate the Englishman, Frenchman, and Irishman highest, and Armenian, Hindu, and Turk lowest In their neutral acceptance reactions, the Chinese, Italian, and Negro rate highest, and the American, Englishman, Frenchman, Irishman, and Swede rate lowest In their hostile interacting reactions, the children rate the Hindu, the Japanese, the Jew, the Negro, and the Turk highest, and the American, Armenian, Englishman, Frenchman, and Irishman lowest

E GENERAL CONCLUSIONS

1 What climate of opinion influences children's thinking about nations and races is revealed in the present study by an investigation of the content of their concepts about these nations, the extent to which concepts tend to be stereotypes in the sense of "pictures in the head" as first used by Lippman in his study of the formation of

TABLE 6

NATIONALITY AND RACE ATTITUDES OF AMERICAN CHILDREN

Nation or race		Identification % (in group)	% Friendly interacting reactions	% Neutral acceptance reactions	% Hostile interacting reactions	% Don't know and no reason given
American	1934	74.3	23.8	0.5	0.1	1.2
	1938	66.1	32.4	0.6	0.0	0.9
Armenian	1934	0.0	12.5	11.2	4.0	72.2
	1938	1.2	7.0	6.4	0.6	84.8
Chinese	1934	0.0	22.9	21.5	26.9	28.7
	1938	0.6	44.8	18.2	10.6	25.8
Englishman	1934	9.7	69.2	6.0	1.3	13.8
	1938	13.0	57.2	10.8	2.7	16.3
Frenchman	1934	6.1	56.5	11.1	2.2	24.1
	1938	3.6	47.0	10.9	3.0	35.5
German	1934	21.1	36.7	9.9	18.8	13.5
	1938	14.2	28.5	12.1	25.8	19.4
Greek	1934	2.7	22.4	16.8	17.5	40.6
	1938	2.4	28.8	15.8	8.5	44.5
Hindu	1934	0.0	9.9	13.0	24.2	52.8
	1938	0.0	10.9	10.3	7.9	70.9
Irishman	1934	19.3	46.9	10.8	3.3	19.7
	1938	20.0	49.4	9.1	1.2	20.3
Italian	1934	5.8	37.2	18.8	11.1	27.2
	1938	1.2	29.1	19.7	18.8	31.2
Japanese	1934	0.0	20.1	20.0	25.8	34.1
	1938	0.0	8.5	8.2	58.2	25.2
Jew	1934	11.0	26.5	15.2	26.4	21.0
	1938	4.6	28.2	16.4	22.1	28.8
Mexican	1934	0.6	29.8	18.9	13.7	37.0
	1938	1.2	34.2	17.0	8.5	39.1
Negro	1934	0.0	23.3	25.4	32.1	19.2
	1938	0.0	30.3	20.0	22.8	26.9
Pole	1934	3.1	18.4	13.4	8.9	56.2
	1938	1.5	10.9	10.6	3.9	73.0
Russian	1934	3.2	22.0	17.3	10.7	46.8
	1938	2.7	24.2	15.2	9.4	48.5
Scotchman	1934	6.2	35.7	17.0	9.0	32.2
	1938	6.9	30.3	15.5	4.9	42.4
Spaniard	1934	0.9	35.9	16.1	7.3	39.9
	1938	0.6	28.5	18.2	9.4	43.3
South American	1934	0.4	32.6	15.9	5.5	45.7
	1938	0.3	23.1	12.4	2.1	62.1
Swede	1934	2.1	34.6	14.1	4.0	45.1
	1938	3.3	37.9	10.0	1.2	47.6
Turk	1934	0.1	7.5	13.7	23.0	55.7
	1938	0.0	10.3	12.4	15.2	62.1
Average	1934	7.9	29.7	14.6	13.2	34.6
	1938	6.8	28.6	12.8	11.3	40.4

public opinion, their reasons for liking, disliking, and being indifferent to various nations and races studied, and the significance of their concepts as cues or sets for social interaction in the American scene

2 These findings can more adequately be understood if interpreted in the light of previous studies concerning their preferences and attitudes. Previous studies reported are "*Group Differences in Nationality and Race Preferences of Children*" (11) and "*Attitudes of American Children Toward Peaceful and Warlike Nations in 1934 and 1938*" (9)

3 Further light on children's development of nationality and race concepts can be obtained by a study of grade to grade development and sex differences in these grades. This study is now in progress

4 For obtaining deeper insight into the formation of these concepts and attitudes, further study by the use of intensive interviewing methods including selected clinical case studies is indicated.

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SHORT ARTICLES AND NOTES

The Journal of Genetic Psychology, 1941, 58, 201-209

TICKLING AND LAUGHTER: TWO GENETIC STUDIES*

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Until the past decade studies of laughter were concerned principally with the laughter of adults and with the principles by which laughter producing situations could be classified (theories of laughter). The approach was speculative and theoretical rather than observational. Recent studies, on the other hand, have been largely observational and at the nursery school level.

Tickling was used sparingly or not at all in these investigations. Nevertheles, one investigator reports, after an extensive use of a wide variety of stimuli on nursery school children, that tickling was the most dependable stimulus for the production of laughter (1).

Little is known about the genesis of the laughter response to tickling during the pre-nursery school years. One of the few comprehensive investigations of smiling and laughter during the first year is that by Dr. Ruth Washburn more than 10 years ago (2). Though Dr. Washburn herself was usually unsuccessful in producing laughter through tickling, she reports that the mothers, when requested to make their babies laugh, usually resorted to tickling. The following two paragraphs contain practically all Dr. Washburn has to say on the relationship of tickling to laughter in this monograph (pages 480-481):

> "Tickling. Several possible ways of stimulating the child by tickling were on the schedule, but these were used with extreme conservatism, and, if at all, only at the end of the hour interspersed with dressing and measuring. The methods were

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*Received in the Editorial Office on November 4, 1939.

> as follows: With the subject in the preferred position, either dorsal or seated, he was touched lightly just under the jawbone on either side of the face, or, while the infant's knees were bare, the experimenter's fingers were played over them lightly. A third method was to lean over the dorsal child (or forward to the seated one) and whisper in his ear "Sometimes this is fun" (note the number of sibilants in the sentence) Most frequently however the mother was asked to report on the ticklish places discovered in dressing, etc When the mother was asked "to make the child laugh" with no indication of how to try to do so, she usually attacked him with intent to tickle, the most favored regions being under the chin, under the arms or in the center of the abdomen
>
> "Comment The experimenter was successful in eliciting laughter only once in response to tickling (24 weeks) The incidence of negative response and smiling response was about equal from 24 to 52 weeks The mothers were successful in eliciting laughter (one subject at each age level) at every level from 24 to 52 weeks"

The comparative wealth of studies on the two to six year age levels and their dearth during the first two years is due, of course, to the presence of large groups of children available for experimental purposes in modern nursery schools. Infants below the preschool age are not conveniently grouped and usually live exclusively under home conditions which cannot readily be controlled for experimental purposes. Nevertheless, it is during the first two years of life that the laughter responses to tickling, as well as to other stimuli, originate. By the time the child enters nursery school those responses are well established

The general purpose of this investigation was to observe the genesis and development of the relation between tickling and laughter during the first year until that relationship had become more stable, more specifically, we sought to discover whether or not laughter would appear in response to tickling, as an aspect of the maturational process independently of any association with other laughter provoking stimuli A secondary object of the investigation was to observe the characteristics of the total response pattern made innately to tickling

To isolate the tickling stimulus from other possible laughter producing stimuli, it is necessary to permit tickling of the baby only when those stimuli are absent That is to say, the baby should never be tickled when he can see or hear a person laughing or when laughter is being produced or facilitated in him by jouncing, a peek-a-boo game or the like

Since dependable controls are difficult to introduce in the average home, it seems worth while to report the findings secured with one boy and one girl who did spend the first year of life under the conditions described in the preceding paragraph (A study of only one individual is significant, if there is reason to believe that the study is of a characteristic in which he is probably typical of humanity in general) These children were the author's fourth and fifth children respectively According to periodic examinations given them by the staff of Fels Research on prenatal and postnatal development, they had no physical, emotional, or other abnormalities, though they were both somewhat above average in mental and physical development.

The mother's cooperation was elicited in not tickling these children, and in seeing to it that no one else tickled them, apart from the experimental sessions During those sessions the children were tickled first lightly and then fairly vigorously by the author's, or the mother's, fingers, or occasionally by a tassel, under the armpits, along the ribs, under the chin, in the sides of the neck, inside the knees, or on the soles of the feet Before approaching the infant, the experimenter always concealed his face behind a 12" by 15" piece of cardboard, having a narrow slit in front of each eye through which the infant could be observed[1] While tickling, the experimenter always sought to keep a smileless, sober expression, even though his face was hidden behind the cardboard shield

The experiment was started with the first child when he was five weeks old and with the second child when she was 14 weeks old In neither child could laughter be elicited by tickling at the start of the experiment Both children laughed in response to other stimuli (jouncing, peek-a-boo games, etc) before they laughed in response to tickling. It was not until the boy was 31 weeks old and the girl 25 weeks old that laughter usually followed the tickling

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[1] There were three exceptions to this procedure In one session a piece of linen, and in another session the left hand, was held in front of the face The third exception was the tickling effect of calipers on the ribs, during a medical examination

In both children laughter in response to tickling became firmly established during the third quarter of the first year.

The following are the notes taken by the experimenter immediately following each experimental session. Incidental observations on smiling and laughter responses to other stimuli than tickling are included in brackets.

R L Male Born November 23, 1932

12-28-32 9 A.M. 5 weeks. R L lying on bed dozing. When tickled he squirmed, moving arms, legs, trunk, and head. Started to fret. Opened eyes.

(R L smiled spontaneously when about six weeks old. He smiled sometimes after a long nap or a good meal. A few weeks later he usually smiled when smiled at by his mother or by me.)

1-10-33 9 30 P.M. 7 weeks. R L awake, waving arms, and fretting a little. Tickling results in increased movement and continued fretting.

1-26-33 9 30 P.M. 9 weeks. R L awake, waving arms, and making up and down movements with legs. When tickled his movements increased, he squirmed, fretted and cried.

(2-17-33 10 A.M. 12 weeks. After his bath, his mother moved his arms upwards, downwards and sidewards and bent them singing "Up and down, and down and up", and smiling. R L gave his first chuckle. When this situation was repeated toward the end of the same day no particular reactions appeared.)

2-19-33 4 P.M. 12 weeks. One hour after feeding. R.L. awake. When tickled he moved and started to cry.

(2-23-33 9 30 A.M. 13 weeks. R L naked at the Fels House for physical examination by Dr. H. When Dr. H's calipers touched R L's ribs he laughed aloud. Dr. H did not have any cardboard sheet or other screen in front of his face but he was reading the measurements at the time and had a completely sober expression.)

2-26-33 10 A.M. 13 weeks. R L in bathroom. On table. Naked. Had just had a bath and was in a good humor. When tickled there was an increase of movement of arms and legs and trunk. The head moved from side to side, but there was no laughter, not even a smile.

(2-27-33 9 45 A.M. 13 weeks. After his bath his mother oiled him all over while talking and smiling to him, when she said "Boo! Boo!" to him he laughed aloud.)

3-5-33 10 A M 15 weeks After his bath his mother tickled him all over several times He was very active. He did not smile or laugh

3-12-33 9 30 A M. 16 weeks After his bath while he was still naked, I tickled him all over No particular reaction

3-20-33 7 30 P M 17 weeks R L lying on bed and playing with a rattle and his foot, Did not make any special reaction when tickled all over, except that when tickled on the cheek he tended to open his mouth

(Same day and time When I smiled and laughed at him while raising and lowering his right arm he chuckled and laughed mildly)

4-15-33 10 A M 20 weeks R L had just had a bath He was naked, active, and in good spirits. There was no special reaction in response to tickling; he seemed to pay little attention to it

(4-17-33 10 P M 20 weeks After evening feeding while his eyes were closed he smiled repeatedly without the application of any apparent external stimulation Smiling under such conditions as these is a fairly frequent occurrence)

4-23-33 21 weeks. Same stimuli and response as at the last session, 4-15-33

(The mother reports that on several occasions when after his bath she has jounced him up and down while laughing and saying "Bouncy, bouncy" he has repeatedly laughed)

(4-24-33 7 P.M 21 weeks One hour after feeding while R L was in his mother's lap, D , an older brother, made various sounds while approaching and withdrawing from R L's face and smiling at him D held R L's hands and moved the latter's arms up and down and back and forth R L laughed loudly D said "I make the same sounds Roger makes when he laughs, and then he makes them ")

6-17-33 10 A M. 28 weeks After bath and just before feeding R L seemed in a good humor When I tickled him there was no apparent change in his reaction He continued to coo and babble and thrash around with his arms and legs When I tickled him in the armpits there may have been a slight increase in his activity

(Same date His mother makes R L laugh whenever she wants to by suddenly approaching her head to his and saying "Boo!" rather explosively and loudly while jouncing him a little I can get him readily to laugh by raising him in the air, tossing him up, suddenly letting him go, and catching him again, while smiling at him)

7-2-33 6.30 P M 31 weeks R L lying on bed, fed about an hour ago; good humor. When tickled in the arm pits he chuckled, laughed and squirmed This is the first time he laughs in response to tickling. The tickling was repeated four times, and each time R L laughed Gentle poking and tickling anywhere on the ribs usually elicits chuckling, laughter and squirming. Tickling on soles of feet, inside knees, or under the chin does not cause any particular reaction at present

7-15-33. 33 weeks When R L is tickled while in movement, as when crawling there is no particular reaction to tickling

7-19-33 12 o'clock noon 33 weeks. R L just awakened from nap and standing in his crib When tickled in the ribs he giggled, squealed and sat down. When tickled on soles of feet and inside knees he smiled After being stood up again in his crib he was once more tickled in the ribs He again squealed, laughed hard, and sat down. A little later while he was trying to reach for something, he was tickled once more, he squirmed very slightly but paid little attention to the tickling. There was no laugh.

9-15-33 to 9-26-33 41 to 43 weeks Almost always whenever I tickle him in the ribs he laughs heartily When I continue to tickle he tries to keep my hand away holding it in his, squirms a good deal.

10-1-33 2 P M. 44 weeks. When tickled in armpits and along ribs R.L laughed but sought to hold my hands and to push them away When I tickled the soles of his feet and inside his knees he moved feet and legs away, seemed to pay little attention to the tickling and did not laugh

10-8-33 2 P M. 45 weeks Just after feeding R L. was sitting in a chair playing with a chain The soles of his feet were tickled, through the stockings, repeatedly—at first gently, then more strongly, the feet moved but otherwise there was no reaction

E.L Female, Born February 2, 1936

(5-12-36 14 weeks. During the past month E L. has frequently chuckled when her mother made sudden noises with her lips, such as kissing or whistling sounds, or when her mother smiled and laughed at her, or when her mother slapped her gently on the buttocks E L. tends to chuckle when sounds are suddenly made by a face approaching hers. Usually, however, she merely looks at the approaching face, squirms, and opens her eyes and mouth wide, the breathing may come more quickly and in little gasps.)

5-30-36 9 30 A M 17 weeks E L lying quietly on bed. When tickled, there were movements of head, arms, and legs, wrinkled forehead. She did not seem to like it

7-23-36 7 P M 25 weeks E L lying on bed When tickled along ribs on her undershirt, she squirmed, there were movements of the arms and legs, the mouth opened and there were chuckling sounds. On further tickling there was no response other than general movement (Opening of mouth seems to be a part of a general response to stimulation When she is at rest and relaxed the mouth is closed Opening the mouth wide and breathing in quick gasps seem to be the forerunners of chuckling, the guttural sounds of chuckling seem to be the precursors of laughter)

7-28-36 4 P M 26 weeks. E L. on bed waving arms and legs When tickled she chuckled When the tickling was continued, she arched her back, turned from side to side, squirmed, and finally whimpered. Tickling elsewhere than along the ribs did not bring about any particular reaction

11-1-36 39 weeks For the past couple of months tickling along the ribs and in the arm pits regularly produces laughter She sometimes laughs also when tickled inside the knees and on the buttocks.

LAUGHTER AN INNATE RESPONSE TO TICKLING

Tickling along the ribs and under the arm pits, especially when done suddenly, was found to be an innate and dependable stimulus for laughter in both children during and after the third quarter of the first year

SMILING

In both these children smiling occurred under two totally different types of circumstances. First, under conditions of apparent well-being as after a meal or a nap when the baby seemed to be warm, rested, relaxed, and comfortable This smile did not seem to be in response to any particular external stimuli It looked like a spontaneous smile of smug satisfaction and was not associated in any way with laughter Secondly, at the beginning of the application of some laughter producing situation, such as tickling, and before the occurrence of the full-fledged laugh, this smile was relatively independent of any particular bodily condition and was the forerunner of the laughter produced by external circumstances.

CHANGES OCCURRING WITH EXPERIENCE IN THE TICKLING SITUATION

After repeated tickling, the sight of the experimenter's slightly moving fingers held directly above the baby became a conditioned stimulus for alert, tense attention, increased general bodily activity, smiling, chuckling, and occasionally laughter The sudden thrust of the moving fingers toward the baby's ribs became a dependable conditioned stimulus for laughter

Both infants tickled themselves on several occasions, but without producing responses at all as strong as when the experimenter did the tickling This failure may have occurred because their tickling was too light and gentle and lacked the tension producing element of uncertainty characteristic of tickling by someone else. To be effective as a laughter producing stimulus, the tickling had to be reinforced by a background of at least mild muscular tension.

The infant's responses in the experimental situation became fairly standardized If the experimenter's fingers slowly approached his ribs, the infant while typically squirming, smiling and chuckling, usually held or pushed against the fingers, but, if the fingers did not continue their advance, the infant commonly pulled them toward him and, once he had learned the words, would say *"Tickle me"*

If the infant laughed while being tickled as he stood up, he usually promptly sat down, apparently because the leg muscles became too relaxed to support him. The relaxing effects of laughter were frequently obscured by the fact that as soon as he had been tickled once, the infant usually made some effort to assure further moderate tickling

During the tickling there was much squirming and general bodily movement, the amount of this movement seemed to be in inverse proportion to the quickness of onset, and amount, of laughter If the tickling was continued more than a few seconds, the infant usually grasped the tickling fingers and pushed them away though, once he had succeeded in doing so, he frequently pulled them back saying, *"More tickling"* If he did not succeed in pushing the fingers away and the tickling was continued for a minute or so in fairly vigorous fashion the laughter gave way to fretting and crying

TICKLING AND CRYING

Tickling for a few seconds at a time caused mild squirming and laughter and seemed to be pleasant Both children invariably wanted more of it. On the other hand, sustained vigorous tickling, especially along the ribs and in the arm pits, seemed to be overly exciting for the children It caused violent bodily movements and eventually crying Both babies seemed to enjoy mild, intermittent tickling and to dread sustained tickling They used their hands as best they could to control the experimenter's fingers to produce a maximum of the former and a minimum of the latter

CONCLUSIONS

As far as these two infants were concerned, squirming and other general bodily movements, smiling, chuckling, and laughter appeared innately (through maturation), between six and seven months of age, in response to mild, intermittent tickling, especially in the arm pits and along the ribs, those responses could sometimes be elicited by tickling the soles of the feet, underneath the chin or on the side of the neck The laughter pattern became conditioned, before the end of the first year, to the sight of moving fingers held above the infant and especially to their sudden thrust toward the infant's body. Vigorous sustained tickling invariably produced violent bodily movements and crying

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The Journal of Genetic Psychology, 1941, 58, 211-217

THE RELATION OF "STUDENT INTEREST" AND "STUDENT NEED" IN EDUCATIONAL PSYCHOLOGY TO OTHER VARIABLES*

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A PURPOSE OF THE STUDY

Implicit in much current educational philosophy is the assumption that students will learn with markedly greater efficiency if the specific learning situations comprising the curriculum are adjusted to the self-expressed interests and self-recognized needs of the particular learners concerned. The present study proposes to make a tentative and partial evaluation of the above assumption as related to elementary educational psychology

B PROCEDURE

Forty-nine University of Georgia students enrolled in an elementary educational psychology class taught by the senior author were asked to rate, on a five-point scale, the several problems in Lehman and Stokes' *Workbook in Educational Psychology* Separate ratings were made of each problem in the workbook by each student with respect to (*a*) personal interest in the particular problem, (*b*) estimated importance (i e , need) of the particular problem to in-service teachers Each problem was rated separately for interest and for importance by each student on two separate occasions. The first ratings of problems were made prior to instruction on the problems Such ratings are referred to hereinafter as pre-ratings The second ratings on each problem were made after instruction on the problems, consisting of individual study and class discussion, was completed All such ratings are referred to hereinafter as end-ratings In the statistical treatment of these data, all ratings on both scales were assigned arbitrary weights from "1" (least favorable) to "5" (most favorable).

In addition to the pre-ratings and end-ratings on interest and on

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*Received in the Editorial Office on November 21, 1939

importance of the several problems the following supplementary data were employed (*a*) Pre-test and end-test of achievement on the problems and (*b*) intelligence test scores The pre-test and end-test of achievement on the several problems were of the objective type Each such test consisted of 20 items each, and each item was based on the official references to the particular problem The intelligence test scores were obtained from the Otis *Self-Administering Test of Mental Ability, Higher Examination*

The total source data described above were analyzed to throw light on the following questions (*a*) What is the effect of instruction on the interest ratings of particular problems? That is, do students become more interested or less interested in problems as a result of instruction? (*b*) Do student interest-estimates of particular problems become more alike or less alike as a result of study and discussion of such problems? That is, does instruction tend to increase or decrease individual differences in problem interest? (*c*) What is the effect of instruction on the importance-estimates of particular problems? That is, does the study and discussion of particular problems tend to increase or decrease the importance-estimates of such problems? (*d*) Does study and discussion of problems tend to increase or decrease individual differences in the importance attached by students to such problems? (*e*) What is the relation of the pre-ratings and end-ratings of interest in particular problems to the pre-test and end-test of achievement in those problems? What is the relation of the change in interest from pre- to end-rating to the change in achievement from pre- to end-test? (*f*) What is the relation of the pre-ratings and end-ratings of interest in particular problems to intelligence test scores? That is, to what extent are intelligence test scores predictive of the pre-interest or end-interest of students in particular problems? (*g*) What is the relation of the pre-ratings and end-ratings of the importance of particular problems to the pre-test and end-test of achievement in those problems? What is the relation of the change in importance from pre- to end-rating to the change in achievement from pre- to end-test? (*h*) What is the relation of pre-ratings and end-ratings of the importance of particular problems to intelligence test scores? That is, to what extent are intelligence test scores predictive of the importance attached by students to particular problems prior to, or following, study and discussion of those problems?

Careful effort was made to secure maximum interest and co-operation in the entire experiment. Each student was assured that none of his ratings on the several problems would in any sense affect his mark on the course A lively interest in the experiment on the part of the class was manifested throughout Interim progress reports on the experiment were made from time to time The writers are convinced that there was little, if any, conscious or deliberate malingering on the part of the students participating It appears obvious to the writers that such errors as are present in the data are of a sort which could not reasonably be avoided in any typical teaching and learning situation That is, it is believed that while additional refinement of procedure, in an effort to secure more exact measures on the several variables, might yield slightly more reliable findings than those hereinafter reported, the increased reliability so obtained would be spurious in the sense that it would be based on atypical teaching and learning situations

C SUMMARY OF FINDINGS

Although data are available for analyses of the various problems in the Lehman and Stokes' *Workbook*, only the findings obtained on Unit 8 (Transfer of Training—Problems 44-49, inclusive) will be presented here since these results are typical of those obtained from the entire study. Tables 1, 2, and 3 present data, pertinent to the eight questions raised above, on Problems 44-49, inclusive,

TABLE 1

THE AMOUNT AND RELIABILITY OF DIFFERENCE IN MEDIAN PRE- AND END-RATING OF INTEREST

Minus Signs Indicate the Difference Favors the Pre-rating Coefficients of Variation are Shown at the Base of the Table.

	44†	45	46	47	48	49	Unit VIII
Median Pre-rating	3.50	4.52	3.68	4.50	4.59	4.36	22.37
Median End-rating	3.75	4.48	3.50	4.68	4.40	4.50	22.50
Diff in Medians	25	— 04	— 18	18	— 19	14	13
Critical Ratio	2.57	38	1.71	1.71	1.56	1.47	36
Chances in 100 of a True Difference	94	61	87	87	85	84	59
V Pre-rating	22.34	16.60	23.56	17.20	18.30	17.26	13.14
V End-rating	29.64	18.78	24.80	16.72	20.17	17.72	15.21

†See bottom of page 215 for problem titles

TABLE 2

THE AMOUNT AND RELIABILITY OF DIFFERENCE IN MEDIAN PRE- AND END-RATINGS OF IMPORTANCE

Minus Signs Indicate the Difference Favors the Pre-rating
Coefficients of Variation are Shown at the Base of the Table

	44†	45	46	47.	48	49	Unit VIII
Median Pre-rating	3.90	4.38	3.72	4.76	4.13	3.90	22.40
Median End-rating	3.95	4.42	3.79	4.89	3.81	3.88	22.10
Diff in Medians	— .05	.04	.07	.13	— .32	— .02	— .30
Critical Ratio	.41	.80	.61	1.06	2.54	.17	.73
Chances in 100 of a True Difference	61	71	66	76	95	54	69
V Pre-rating	25.81	19.45	25.29	19.65	20.07	30.19	10.80
V End-rating	29.73	17.62	26.65	18.36	21.20	25.53	8.95

†See bottom of page 215 for problem titles

and for Unit VIII as a whole. The obtained findings may be summarized briefly, as follows:

1. There is no constant or statistically reliable tendency for study and discussion of problems to increase or decrease the measured student interest in such problems.

2. There is a slight but fairly consistent tendency for instruction on problems to be accompanied by an increase in individual differences in student interest in such problems.

3. Instruction on problems has no constant or statistically reliable effect on the importance attached by students to such problems.

4. There is a slight but inconsistent tendency for instruction on problems to be accompanied by a decrease in individual differences in the importance-estimates of such problems. That is, students are in closer agreement among themselves concerning the importance of problems at the conclusion of instruction than was the case prior to instruction.

5. No appreciable or statistically reliable correlations are found between pre- or end-measures of interest and pre- or end-measures of achievement. That is, neither the pre-measure nor the end-measure of student interest in problems is predictive of the measured knowledge of those problems possessed by students prior to, or at the conclusion of, instruction on such problems. No statistically reliable correlations are found between the change from pre- to end-interest ratings and change in achievement from pre- to end-test scores

TABLE 3

ZERO ORDER CORRELATIONS AMONG THE SEVERAL VARIABLES

	44†	45	46	47	48	49	Unit VIII
Pre- and End-Interest	48*	44*	45*	37*	38*	57*	53*
Pre- and End-Importance	31	88*	43*	28	22	38*	46*
Pre-Interest and Pre-Ach	—03	04	04	03	06	07	09
Pre-Interest and End-Ach	—01	12	—02	02	15	19	07
End-Interest and End-Ach	—02	04	05	—03	06	—06	—09
Pre-to end Change in Int and Pre-to-end Change in Ach	16	12	10	—01	—09	00	06
Pre-Interest and Intel	01	03	04	—09	—01	08	—01
End-Interest and Intel	05	11	07	—01	—04	08	—12
Pre-Importance and Pre-Ach	02	05	04	—03	—.10	08	—07
Pre Importance and End-Ach	03	00	09	03	04	—28	—12
End-Importance and End-Ach.	10	08	—06	—07	—07	11	—02
Pre-to-end Change in Imp. and Pre-to-end Change in Ach	23	—12	13	—02	—09	07	13
Pre-Importance and Intel	—10	06	—07	—10	—09	—11	—14
End-Importance and Intel	—11	—10	—13	01	—03	—04	—19

†The titles of the several problems referred to in Tables 1, 2, and 3 are as follows

Problem 44, Diversity of Transfer
Problem 45, The Influence of High School Subjects Upon College Success
Problem 46, The Transfer of Training: Uncritical Claims
Problem 47, The Teaching of Morals vs the Learning of Morals
Problem 48, Scholarship vs Professional and Business Success
Problem 49, Scholarship vs Subsequent Financial Success

*Correlations thus marked are statistically reliable

That is, changes in interest ratings are not predictive of changes in achievement test scores

6. Intelligence test scores are not predictive of the pre-interest or end-interest of students in the problems under investigation

7 The importance-estimates of particular problems prior to, or at the conclusion of, study and discussion of such problems are neither reliably nor significantly related to the measured knowledge of such problems possessed by students prior to or at the conclusion of, instruction on such problems. No statistically reliable correlations are found between the change in importance ratings and change in achievement test scores. That is, changes in importance-estimates are not predictive of changes in achievement test scores

8 Intelligence test scores are not appreciably or reliably predictive of the importance attached by students to particular problems either prior to, or at the conclusion of, study and discussion of such problems

D Conclusions

It should be emphasized that the classroom experiment herein reported was designed to test the predictive values and pedagogical usefulness of measures of student interest and of student need The measures of student interest and student need herein employed were based on the specific curricular content (i e, problems in Lehman and Stokes' *Workbook in Educational Psychology*) of one elementary course in educational psychology If their reliability and validity be tentatively assumed, the findings reported above, although generally negative in nature, appear to have important implications for educational theory and practice For example, it appears that neither the self-expressed interests nor the self-evaluated needs of learners in particular curricular content can be used to predict (*a*) the intelligence of the learner, (*b*) his previous mastery of specific curricular content, nor (*c*) the extent to which he will apply himself profitably to "interesting" and "needful" curricular material In contrast to the generally negative findings reported above, certain supplementary findings should be noted, as follows· Intelligence test scores are appreciably predictive of final examination scores (r = 63 ±.06), of pre-achievement scores on a given unit (r = .62 ± 06—Unit VIII); of end-achievement scores on a given unit (r = 56 ± .06 —Unit VIII). On Unit VIII relatively high reliability coefficients are obtained on the rating scales of pre-interest (r = .79 ± 03), of end-interest (r = 84 ± .03), and of pre-importance (r =

93 ± 02), although the reliability of the end-importance ratings (r = .38 ± 08), is rather low. On the basis of the total data available the writers conclude that the measures of self-expressed interest and self-recognized needs herein employed do not have sufficient predictive value to warrant their routine use as instructional aids in educational psychology Stated differently, the above findings appear not to be in conformity with the educational philosophy under evaluation It may well be, however, that the above findings merely indicate that the measures of interest and need herein employed are not suited to the measurement of the genuine interests and needs of prospective teachers

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The Journal of Genetic Psychology, 1941, 58, 219-232

BOOKS

The *Journal of Genetic Psychology*, the *Journal of General Psychology*, and the *Journal of Social Psychology*, will buy competent reviews at not less than $2 per printed page and not more than $3 per printed page.

Conditions. Only those books that are listed below in this section are eligible for such reviews. In general, any book so listed contains one or more of the following traits: (*a*) Makes an important theoretical contribution, (*b*) consists largely of original experimental research, (*c*) has a creative or revolutionary influence in some special field or the entire field of psychology, (*d*) presents important techniques.

The books are listed approximately in order of receipt, and cover a period of not more than three years. A reviewer must possess the Ph.D. degree or its equal in training and experience.

Procedure. If among the books listed below there is one that seems important to you, you are invited to write a review of that book. It is not necessary to make arrangements with the Editor. Just send in your review. It does not matter if the book in question has been reviewed before.

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CRITICAL REVIEWS OF RECENT BOOKS

(*Gesell, A., Amatruda, C. S., Castner, B. M., & Thompson, H. Biographies of Child Development. New York: Harper, 1939. Pp. 328.*)

REVIEWED BY LIVINGSTON WELCH

The most unquestionably important yet treacherous task in child psychology is making prognoses of traits and abilities of individual cases from the observations of the first year or two of life. Within the arbitrary confines of statistical methodology such an undertaking inhibits the resourcefulness of the most optimistic dreamer. The one hope lies in the field of the extensive biographical study that covers in each case a span of many years. Obviously, this method has little of the reliability of strict statistical procedure, but it is far better than none. Certainly, the possibility of such predictability cannot be neglected simply because it will not admit of statistical analysis.

Examples of biographical analysis that should remain as classics are to be found in this book. The cases under discussion are limited to 84 and these have been carefully selected from many thousands. The small number may not arouse as much suspicion as that sentence in the introduction which reads:—"It is not the purpose of the present volume to summarize the totality of records, but rather *to select* from the entire array some of those which have had special significance from the standpoint of clinical application or of developmental psychology." The case rests or falls on the judgment of those who have done the selecting. An examination of over 10,000 children during a period of 25 years by the staff of the Yale Clinic of Child Development should suggest the minimum error of this type.

The authors seem to be fully aware of the difficulties of their task:

> Our data do not lend support to the concept of a relatively standard pattern of infancy. Nor are the findings of embryology in harmony with such a concept. From the standpoint of embryology the infant is already far advanced in the cycle of life. He is already stamped with individuality rather than a standard pattern. . . . Infants are individuals almost infinitely removed from a zero point of homogeneity.

On the other hand, Dr. Gesell and his associates maintain that there are many stable factors concerning mental growth and many others whose lability is definitely limited They believe that "a constitutional core of characteristicness determines the way in which the individual will meet new situations and incorporate them" They stress the fact that "environmental factors support, inflict and modify but do not generate the progression of development."

Thirty of the biographies which they present indicate success regarding latent predictability in the early phase of the life cycle. The prognoses are based on what the authors call "a judicious weighting of probabilities based on normative determinations" They explain that "prediction under these conditions can thus be carefully graduated to the inherent genetic probability behind the symptomatic behavior patterns." They define "genetic probability" as one that is not "a mere actuarial probability nor one that depends upon an indifferent principle of uncertainty, or a neutral condition of utter randomness, since the very word genetic suggests a living organism which grows, and which is so charged with certainty that under given, specific conditions it is bound to assume characteristic forms and functions" They insist that there are endless numbers of growth characteristics that are certain. The major example given of the principle is the zygote which under normal conditions is certain to become an embryo, that in turn develops into a fetus, next into an infant, a child, and last a man "The sequences," they maintain, "are governed by inherent genetic probabilities which make prediction possible" It is somewhat difficult at this point to understand the precise distinction they are making between the socalled two types of probability What they define as "genetic probability" could still be confused with what they term "actuarial probability" In the ultimate analysis there is but one type of probability, which admits of varying degrees.

They list 12 principles which underlie developmental diagnoses of infant behavior Among these are the following —

"The growth characteristics of the infant are primarily determined by hereditary and constitutional factors which undergo their basic organization in the uterine period"

"The factors do not operate independently of postnatal environmental influences, social and physical, but they determine the direction and scope of such influences."

"A norm is a standardized tool for discriminative characterization"—not a unit of measurement It merely represents "a positional value rather than an absolute value in a calibrated scale of equal units."

In actuality, the predictions made concerning individual cases discussed in this book are of a very general nature The authors admit, "Our present criteria for estimating growth may well be considered crude" They add, however, that "the very nature of growth confers upon them a great deal of indicativeness" Evidence is presented of their having predicated musical talent, "dynamic quality" and general mental ability Moreover, they innumerate nine items which they found to be of the greatest value in predicting reading disability These include scattering and inconsistency of the individual developmental examination, specific weakness in drawing tests, in number concepts, atypical directional tendency in drawing, the presence or history of sinistrality (total or partial), immature or excitable personality, and a history of reading disability in the family

They claim that "certain signs of superiority appear at a very early age," but explain that "in general the detection of potential superiority in infancy is less certain by ordinary procedures than is the recognition of deficient or average ability" Case histories are given of retardation in infancy with superior ability manifested by the fifth year, as well as those of consistent superior development or accelerated mental growth.

Apart from any specific interest in predictability, much is to be gained by a careful study of a great number of the biographies of atypical cases These consist of brief summaries of the results of examinations and tests made during the first year of each subject together with as many as two and three follow up examinations sometimes covering a span of 10 years They include instances of mongolism, retardation from hypothyroidism infancy that was later improved by thyroid therapy, birth traumas, accidental asphyxia, streptococcus meningitis, congenital cataracts and myopia hydrocephalus, and spina bifida

Both the clinical material and theoretical discussions are the most interesting products that so far have come from the Clinic of Child Development at Yale They constitute invaluable contributions to child psychology and psychiatry.

Institute for Research in Child Psychology
Hunter College
New York City

(*Muenzinger, K. F. Psychology The Science of Behavior. Denver World Press, 1940 Pp XIII + 343*)

REVIEWED BY EGON BRUNSWIK

In contrast to an increasing number of texts meeting the pattern of interests which the student is supposed to bring with him as he hesitatingly approaches academic Psychology, this is a book "to be read as one would read a text in algebra or geometry" (p. XII).[1] Little use is made of the common errors of popular psychology as a convenient apperceptive mass from which to start. There is no gentle guidance away from common sense and toward a more rigorous conception of psychology as a science, but rather a sudden dive into a sketchily outlined integrative system. "The time has come when even an elementary outline of psychology should be presented through a systematic method which is stated explicitly and applied consistently" (*Introduction for Instructors,* p. VII).

It is this unifying and all-inclusive single theoretical standpoint rather than the pedagogical technique employed which seems to be the author's primary point in writing this book. Its tenor "bears a considerable similarity to purposive behaviorism of the Tolman variety, a behaviorism which is psychological and not physiological" (p. VIII). This implies that the question of an ultimate explanation of the phenomena of goal-seekingness (that is the alternative of mechanism vs. teleology) is left out of the picture, and that the author looks upon the basic phenomenon of the "constancy of direction" of behavior in a strictly descriptive fashion.

Central concept of the book is the "start-to-end unit":

> "We shall . . . use as a *psychological unit of description* cycles of behavior which are characterized by a *constant direction*, i.e., a persistent direction towards the same end-phase . . . When a subject is hungry, he will move towards food, the beginning of the movement, the stage where hunger initiates food-seeking, we may call the *starting-phase*, and the eating of the food, the *end-phase* of this particular cycle of behavior . . . All psychological movement . . . can be divided into such units, which from now on we shall refer to as start-to-end units, or cycles, or intervals, and in abbreviated form as S-E units" (p. 12).

---

[1] The quotations refer to the second edition.

> "The chief advantage . is that . we can discover *recurring similarities.* In every unit we find certain factors which determine the *direction* and *strength* of behavior toward a particular end-phase These we shall refer to as the factors of *motivation* . In every unit we find certain factors which produce an analysis of the psychological situation so that behavior can move towards the end-phase. These we shall refer to as the factors of *discrimination* . In every unit we find certain factors which bring about a *modification* of the psychological situation so that the end-phase is brought about These we shall refer to as the factors of *performance.* Such a modification of the situation may imply locomotion, that is, change of place, or manipulation, that is, change of particular aspects of the situation, or still other methods. . In every unit we find certain factors which arise out of changes in the dynamic stresses of the situation These we shall refer to as the factors of *affectivity* Any description of a psychological event in terms of these four categories is complete in the sense that no further category is needed" (p 14 ff)

The concepts thus defined are basically conceived in an objective fashion It is nothing but a constellation of a sequence of events that permits us to say that we have observed, say, the hunger-food motive in an organism.

> "In psychology we have to employ a number of terms of this nature, terms which refer not to single events but to particular constellations of events An outstanding example is the term 'meaning'. Recently Tolman has called attention to the nature of such terms He states that they refer to 'intervening variables', i.e., variables or factors in behavior that are not immediately observable, but factors which emerge through a particular grouping of directly observable factors . (no food for twelve hours, restlessness, steady pushing on toward the goal, devouring of food; hunger-food motive)" (p. 55). "We do not and cannot perceive the subjective core of an emotion in others, but we do perceive a part at least of the situation within which his behavior is moving, to some extent also the dynamic stresses in that situation, and those changes in his behavior which are the immediate expressions of his emotion. It is the totality of a selected number of aspects in his behavior which we perceive as his emotion" (p 131)

The book is divided into four parts The first deals with what is called our "central problem," that is the dynamics of behavior in the "psychological situation" of the organism in its environment "We cannot avoid, however, describing at least those physiological components that play a decisive rôle in determining the nature of the psychological components" (p 20) This is done in the second part In both these parts the four "segments" of the S-E unit are discussed in the sequence mentioned above The third part, more conventional in character, deals with individual differences, personality, social behavior.

The fourth part is a new feature of the second edition It contains three "appendices" one on learning (in which the evidence on this topic presented at various places throughout the book is pulled together), one on "mind and body," and one on scientific method in psychology It is in the latter two of these appendices that the author's operational leanings find their clearest expression though they are not explicitly labeled as such.

The variety and scope of information offered is well in line with that of other texts of comparable size. The grouping of the items however is unconventional in certain respects, due to the author's basic theoretical scheme Sometimes the placing of a certain heading is not quite convincing, e g., when some of the most distinctly environmental aspects of perception are discussed in the section dealing with the "psycho-physiological" technicalities of discrimination The author is aware of this fact, yet finds it "better to force facts into the Procrustean bed of a theoretical structure than to present them in a more or less random order" (p VII). The treatment of the problems discussed is concise There is a great deal of reference to animal experimentation, and generally the more academic aspects are stressed at the cost of specific fields, such as developmental problems, etc

No attempt is made to present complete lists or elaborate classifications of items falling under a certain category (e g, of "needs") Whereas distinctions such as that between the four segments of behavior "must necessarily be clear-cut and exclusive such a need . does not exist when dealing with motives" (p 24). Emphasis is rather on the common features within each category, as illustrated by examples materially different from each other, and thus upon the formal structure of psychological laws The emphasis thereby remains chiefly limited to the *S-E* unit and its subdivisions as a frame of reference. There is relatively little on "interrelations of units," except a brief discussion as to how they may "overlap, form hierarchies, interfere, and conflict with each other" (p 17, 318).

There is no flat rejection of "subjective behavior" ("consciousness") But it is emphasized that the scientific definition of psychological concepts, such as that of motive, perception, meaning, rests in "certain aspects of a subject's behavior as observed by us."

> "At times we may have occasion to talk about the subject's awareness of his perceptions and meanings, but we are not chiefly concerned with his awareness" (p. 64) "As far as tasks are accomplished, the two types of behavior, objective and subjective, are *essentially* alike That is, whenever behavior moves in a subjective manner towards the accomplishment of a task, the same principles are involved as when it does so objectively. To illustrate, in order to reach the solution of a problem a subject may manipulate objects, or he may 'think it out' without any observable movements, in either case he progresses towards a goal . Whatever understanding we reach in dealing with objective behavior is immediately applicable to subjective behavior Here we can be behaviorists" (p. 6)

Emphasis upon the accomplished "task" follows from emphasis upon "ends" as the terminal links of *S-E* units Such an approach will necessarily tend to be what might be called "distal," rather than "proximal" and "mediational," in character The author does not make this fact as explicit or as dominant as it could be. Yet, the general tendency is quite clear. There is also repeated emphasis upon the variability of the intermediary pattern between relatively stable starts and ends.

> "A great deal of confusion still exists regarding the *distinction between uniformity of performance and the uniformity of movements* in learned behavior, that is, in habits Much psychological discussion and theorizing is still based on the unwarranted assumption that learning necessarily means the formation of a uniform pattern of movements" (p 216) "It looks very much as if the *S-E* cycle of behavior were an extension of the automatic homeostasis mechanism, and it is fascinating to speculate how the development from the purely automatic activity to the plastic behavior of the *S-E* cycle

scrutiny he would run the risk of producing an unfortunate hybrid between an elementary text and a programmatic article in the *Psychological Review* Yet, the text is an impressive demonstration of the possibility of a unification, on an elementary level, of the two cardinal avenues of approach, the empirical and the systematic. Uniformity and consistency in the use of technical terms, outlines and repetitions, a concise glossary at the end of the book, and the numbering of paragraphs with a decimal system do their part in emphasizing the formalistic tendencies of the book There is a detailed index in the second edition

Taken as a whole, and with an understanding attitude toward minor imperfections, the book makes it salient that there is teachability in a psychology which is molar, yet not vitalistic, objective, yet not atomistic, and empirical, yet proceeding *more geometrico* Used as a text, the book calls for whole-hearted accord with the basic attitude on the part of the instructor Provided there is such sympathy (which may not be unlikely in our time), its use should make inspiring teaching

Department of Psychology
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Berkeley, California

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June 1941
Volume 58, Second Half

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THE PEDAGOGICAL SEMINARY AND JOURNAL OF GENETIC PSYCHOLOGY

Child Behavior, Animal Behavior, and Comparative Psychology

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Worcester, Mass., under the Act of March 3, 1879

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The Journal of Genetic Psychology, 1941, 58, 235-245

STUDIES IN EVOLUTION. I. THE PHYLOGENESIS OF THE CIRCULATORY SYSTEM*

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F. A. WATERMAN AND R. D. WILLIAMS

The purpose of this paper is to show by a series of three dimensional diagrams the phylogenesis of the chordate circulatory system and to place a new interpretation upon its development. The first form to be described is amphioxus, which in most respects seems to be nearest the line of direct descent. The only structure amphioxus has in the way of a promise of a bony structure is a notochord which is composed of large vacuolated cells and extends on the ventral aspect of the nervous system throughout its entire length and projects anteriorly a little beyond the extreme head end of the system.

There are a number of characteristics of amphioxus which are pertinent to the central thought of this study, several of which can be readily seen by observing Figure 1. In this figure the notation

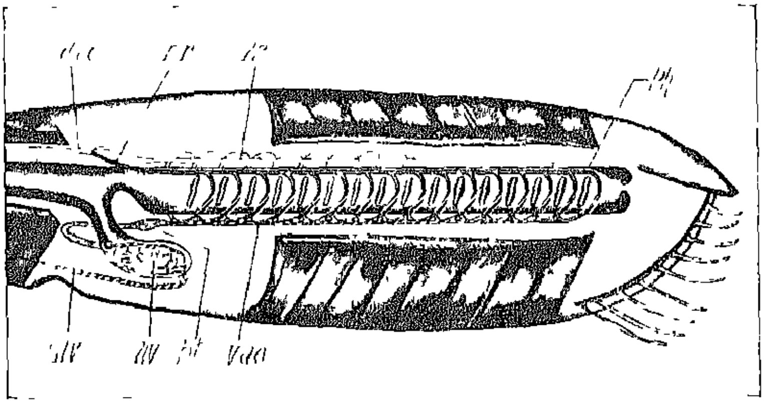

FIGURE 1

DIAGRAM OF THE AORTIC ARCHES OF AMPHIOXUS

d ao, dorsal aorta, *ht*, heart, *liv*, liver diverticulum, *l r*, left radix, *ph*, pharynx, *r r*, right radix, *siv*, sub-intestinal vein, *v ao*, ventral aorta

---

*Received in the Editorial Office on December 1, 1939

ht (heart) indicates a slight swelling of the ventral aorta In many cases it is difficult to observe such a swelling, and the entire ventral aorta is seen to pulsate and to carry on the pumping function of a heart

In the anterior end, the reader can observe 16 pairs of aortic arches However, in the living forms there are anywhere between 60 and 100 such pairs. In Figure 1 they are shown as separated by a large distance from one another, but actually they are in close juxtaposition. The blood travels anteriorly in the ventral aorta and then empties into the afferent branchial arteries from which it circulates through the capillaries of the gill filaments where aeration of the blood occurs From here it flows into the from 60 to 100 pairs of efferent branchial arteries and from them passes into two radices aortae, through these the blood flows posteriorly and empties into the dorsal aorta from which it is distributed to all parts of the body. It then passes through the capillaries, where it gives food and oxygen to the tissues of the body and also takes on the waste products of cell metabolism On passing through the capillaries, it is collected by numerous small veins, which in turn empty into the large sub-intestinal vein This vein passes anteriorly, and after forming a capillary network around the liver diverticulum, it continues its forward course to the heart Here the blood is at the point from which we started to trace its course At this point the reader can easily follow this circuit as sketched in Figure 1. Furthermore, the same identical situation is shown in Figure 2, which exhibits a pump forcing water forward into a large pipe from which emerge several smaller pipes in parallel; and these pipes, in turn, empty the fluid into a large pipe at the other end of these parallel pipes which returns it to the reservoir

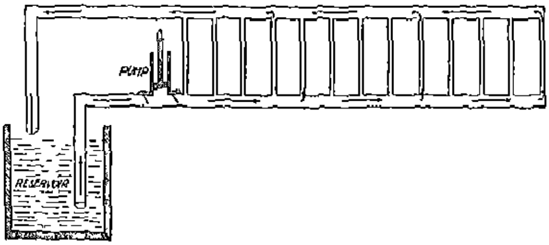

FIGURE 2
DIAGRAM OF A WATER SYSTEM SHOWING PARALLEL CONNECTIVES

In this case the pump need not be a strong one. The energy required to propel the water through these many parallel paths is very small. The same situation, as used in the study of electricity, exists here, and the rule stating the nature of the behavior that takes place is called Ohm's Law. This is a statement of the relation between pressure, resistance, and current, and is formulated as follows

$$\frac{pressure}{resistance} = current$$

From this equation it can be seen that if the resistance is small, then a small pressure can set up a large current. If it were not so, then the prospects would be disastrous for any animal that has a large number of parallel aortic arches because its weak heart would be unable to push the blood through these pipes. In the case of the cyclostomes it is apparent that a great evolutionary step has taken place in that the number of aortic arches has dropped from in the neighborhood of 100 to 8. There is a decided change in the thickness of the heart's wall and its general size. Correlated with this reduction is an increase in the size and the efficiency of the cyclostome's heart.

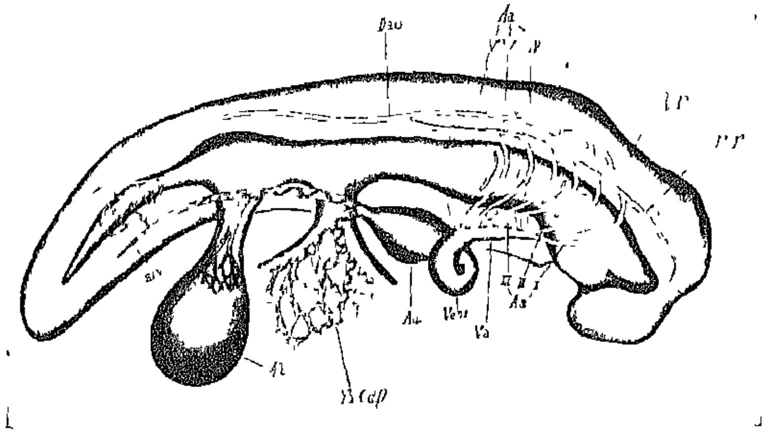

FIGURE 3

DIAGRAM OF THE CIRCULATORY SYSTEM OF A PRIMITIVE VERTEBRATE EMBRYO

Aa, aortic arches I-VI; *Al*, allantois, *Au*, auricle, *D ao*, dorsal aorta, *lr*, left radix aorta, *rr*, right radix aorta, *s i v*, sub-intestinal vein, *va*, ventral aorta, *vent*, ventricle, *ys cap*, yolk sac capillaries

In the case of the generalized vertebrate embryo, the number of gills arches has been reduced to six. This shows that the ancestors of all the higher chordates must have had six aortic arches. The heart begins its development as a swelling of the ventral aorta, but in a short time divides into two chambers, namely, an auricle and a ventricle with a valve separating the two chambers, thus presaging the evolution of a stronger adult heart. A stronger heart is required since the number of parallel openings has been so greatly reduced, that is, from eight to six. This drop is proportionally a great one.

In the case of the bony fish, as shown in Figure 4, there are only four arches. The two anterior arches, shown in dotted lines, have dropped out in the course of evolution. Along with this dropping of these two aortic arches goes a corresponding increase in structure, size, and efficiency of the heart. As we passed from the cyclostomes to the primitive vertebrates, we saw that there was a drop in the number of aortic arches from eight to six. Now again in the passage from the generalized vertebrate embryo to the bony fishes, there is a reduction of from six to four arches. In the passage from eight to six, there is a drop of 25 per cent, and in the latter case there is an additional drop of 33 1/3 per cent.

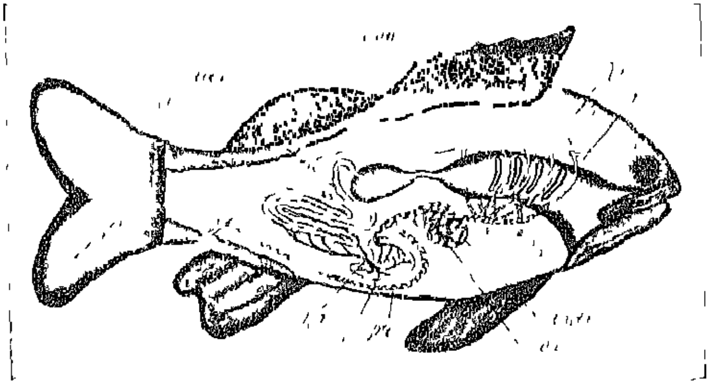

FIGURE 4

SCHEMATIC REPRESENTATION OF THE CIRCULATORY SYSTEM OF THE TELEOST FISH SHOWING THE REDUCTION IN THE NUMBER OF AORTIC ARCHES TO FOUR

I-VI, aortic arches, *au*, auricle, *coe. a*, coeliac artery, *d ao*, dorsal aorta, *h p v*, hepatic portal vein, *int*, intestine, *liv*, liver, *lr*, left radix aorta, *pc*, posterior caval vein, *r r*, right radix aorta, *stom*, stomach, *ventr*, ventricle,

In the case of Necturus, the two anterior arches have disappeared completely, as was true of the bony fishes. However, there are new and significant changes that do occur here. In the first place, the two radices aortae between Arches 3 and 4 have greatly diminished in calibre so that very little blood passes posteriorly through them, thus foreshadowing the formation of the carotid arteries. The fifth arch also becomes greatly reduced in size along its entire length. In addition, the dorsal part of the sixth dwindles in size while the ventral remains intact and forms the pulmonary artery. Along with these changes, which greatly diminish the parallel path aspect of the system and, thereby, introduce more and more friction in the channel of the blood flow, occurs a correlative change in the structure of the heart. The auricle begins to divide into two chambers, a partition forms between the right and the left halves. There is now for the first time a slight tendency toward the separation

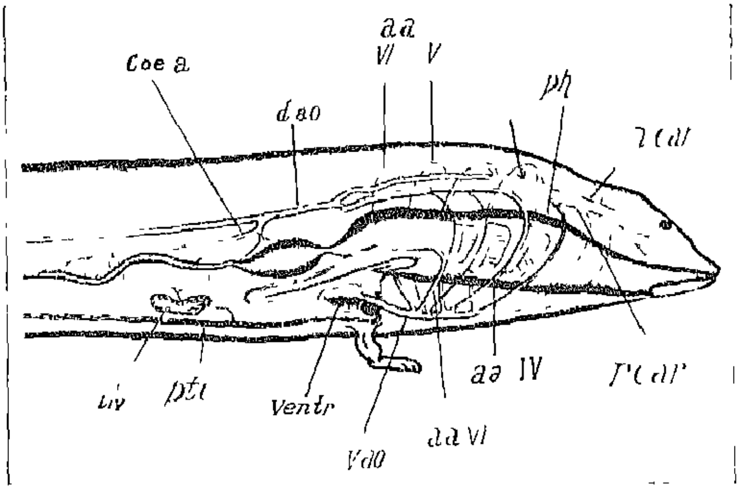

FIGURE 5

Diagram of the Condition of the Aortic Arches in Necturus. The First Two Arches, Which Have Previously Disappeared, are Shown in Dotted Lines

The arrow indicates the dwindled portions of the radices aorta. The auricle of the heart is shown as partially divided into a right and a left half.

aa, aortic arches, *coe a*, coelic artery, *d ao*, dorsal aorta, *l car*, left carotid artery, *liv*, liver, *ph*, pharynx, *ptc*, post caval vein, *r car*, right carotid artery, *v ao*, ventral aorta, *ventr*, ventricle

of the arterial from the venous blood. In this form also there is the beginning of the formation of a lung. All of these changes are clearly shown in Figure 5.

The next step in advance in the shift from the parallel system of arches to the series type is clearly shown in the case of the frog (Figure 6).

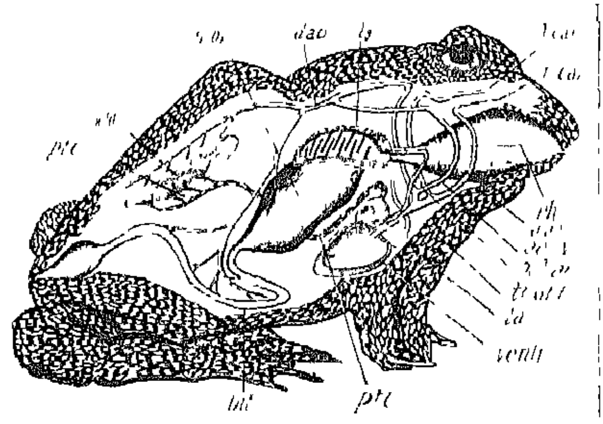

FIGURE 6

Diagram of the Circulatory System of the Frog Showing the Newly Formed Carotid Arteries

The auricle of the heart is completely divided into a right and a left half and a spiral valve has developed in the truncus which partially separates arterial and venous blood as it issues from the ventricle. The portions of the system that dropped out in the course of evolution are shown in dotted lines.

aa, aortic arches, *d ao*, dorsal aorta; *int*, intestine, *kid*, kidney; *la*, left auricle, *l car*, left carotid artery, *lg*, lung, *ph*, pharynx, *ptc*, post caval vein, *pul art*, pulmonary artery, *r car*, right carotid artery, *stom*, stomach, *tr art*, truncus arterosis, *ventr*, ventricle

The radices aortae connecting Arches 3 and 4 have now completely disappeared, and Arch 3 alone carries all the blood to the head. This pair of arches together with the anterior extensions of the radices aortae become the carotid arteries. Arch 5 has also completely dropped out, and the dorsal part of the sixth arch has completely disappeared while the ventral portion of the same arch has become the pulmonary artery.

The lung of the frog has become more complex and more efficient in that the inner mucosa or lining has been thrown into folds, forming primitive alveolar septa In the case of Necturus, the lung was only a hollow sac showing practically no evidence of alveolar structure

The heart has increased proportionally in size and the auricle has now completely divided into two halves or chambers The right auricle has become entirely venous, and the left auricle entirely arterial A mixture of the blood still occurs in the ventricle, which is one large chamber However, there is a tendency for the separation of the outgoing blood from the heart to occur because of a spiral valve which has grown down in the truncus arteriosus.

The next advance in the development of the circulatory system is shown by the reptile (Figure 7) In the reptile the greatest changes are those that occur in the lung and heart. The lung has

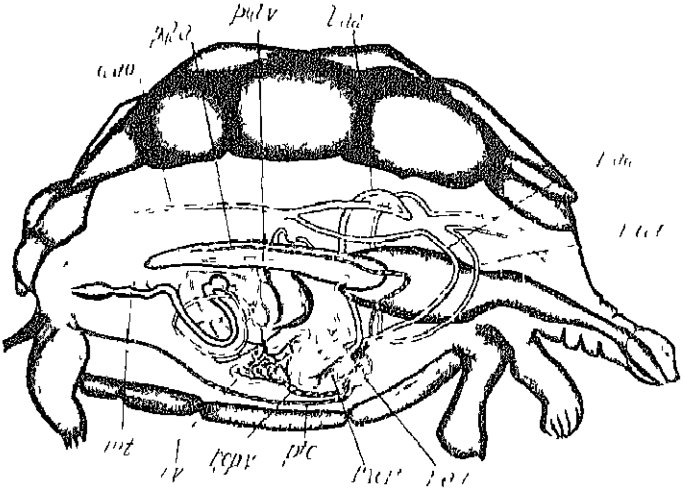

FIGURE 7

Diagram of the Circulatory System of the Turtle Showing the Truncus Arteriosis Divided Into Three Parts and the Nearly Divided Ventricle

The portions of the primitive aortic arches, which have dropped out, are indicated by the dotted lines

d ao, dorsal aorta, *hep v,* hepatic vein, *int,* intestine, *l aa,* left aortic arch, *L A,* left auricle, *lv,* liver, *L V,* left ventricle, *pul a,* pulmonary artery, *pul v,* pulmonary vein, *ptc,* post caval vein, *r aa,* right aortic arch, *r au,* right auricle, *r ca,* right carotid artery, *r vent,* right ventricle become more complex. Alveolar structures are more numerous; this is correlated with the terrestrial habits of these forms.

The heart of the reptile shows an advance over that of the frog in that the ventricle is almost divided into two chambers, thereby, making the separation of the arterial from the venous blood nearly complete.

The truncus arteriosus has divided into three portions, namely, a pulmonary artery which arises from the right ventricle, and the two aortic arches. The left aortic arch takes its origin half way

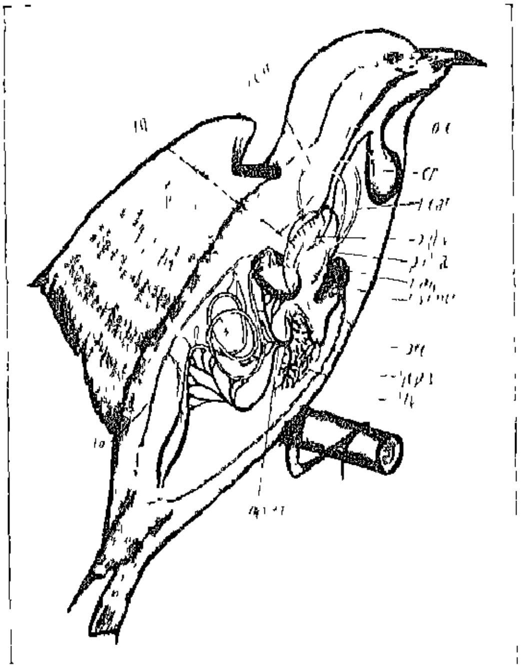

FIGURE 8

Diagram of the Circulatory System of the Bird Showing the Final Transition from a Parallel to a Series Type of Blood Circuit

The heart has become completely divided into four chambers and consists of both a venous and arterial half. The right aortic arch persists.

ao, aorta, *cr*, crop, *hep v*, hepatic vein, *l car*, left carotid artery, *lg*, lung, *liv*, liver, *L Vent*, left ventricle, *or c*, oral cavity, *port v*, portal vein; *ptc*, post caval vein, *pul a*, pulmonary artery, *pul v*, pulmonary vein, *r au*, right auricle, *r car*, right carotid artery, *r vent*, right ventricle, *s i*, small intestine

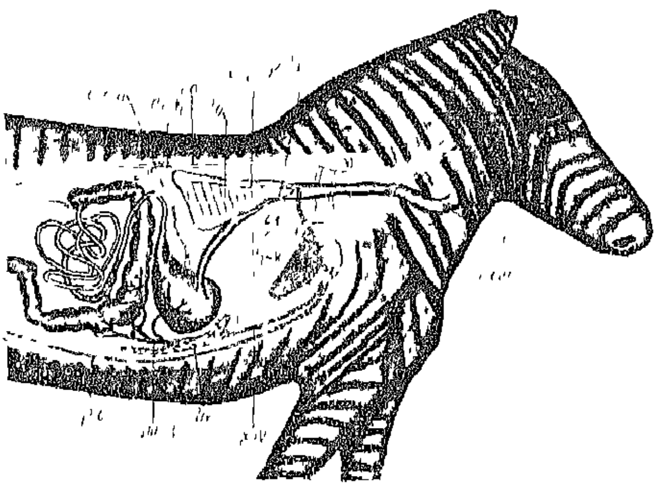

FIGURE 9

DIAGRAM OF THE CIRCULATORY SYSTEM OF A MAMMAL SHOWING AGAIN THE COMPLETED TRANSITION FROM A PARALLEL TO A SERIES TYPE OF BLOOD CIRCUIT

The completely divided heart separates venous and arterial blood, such as is characteristic of all warm blooded animals

ao, aorta, *coe a*, coeliac artery, *diaph*, diaphragm, *hep v*, hepatic vein, *L A*, left auricle, *liv*, liver, *LV*, left ventricle, *oes*, oesophagus, *port v*, portal vein, *pul a*, pulmonary artery, *pul v*, pulmonary vein, *R A*, right auricle, *r car*, right carotid artery, *RV*, right ventricle

between the right and the left ventricles This is the very point at which the septum separating the ventricles is incomplete and, therefore, this arch carries mixed blood into the dorsal aorta The right aortic arch arises entirely from the left ventricle and carries arterial blood to the dorsal aorta

Figure 8 of a bird and Figure 9 of a mammal both show warm blooded organisms Each of these two phyla has a heart that is completely divided into four chambers, thereby, completely separating the blood into arterial and venous portions One outstanding trait of the circulatory system differentiates the bird from the mammal, namely, in the birds it is only the right radix aortae that persists The companion on the left side drops out Instead then of speaking of the fourth aortic arch, the name aorta is given to this trunk line for its entire length In the mammal it is the left radix aortae that survives, and to it also the name aorta is given to the entire length of the trunk line that was once the fourth aortic arch

This study, which is the first of a series, is worked out with a view to showing the bearings of the evolution of the various biological systems on the gestalt interpretation of the mind The present paper aims to show that the circulatory system reveals a beautiful instance of teleological causation There is a shift that gradually takes place in forms, such as the Tunicates that possess as many as 1,000 or more arterial arches and culminates in the mammals and birds As the progressive reduction of arterial arches takes place, there is a corresponding sequence of changes that occurs in the structure of the heart As long as there was a large number of gill arches arranged in parallel, the heart did not become a strong one The load imposed upon the heart in the case of the many parallel pipes was small. Ohm's Law shows that the total resistance of a parallel system is less than any one of the resistances As the number of parallel arches diminishes, the load imposed upon the heart—analogue of a generator—increases So that when those forms are reached where the total quantum of blood is pumped into the aorta, which in turn gives off the carotids, the resistance offered by the circulatory system has been greatly increased Along with this goes a two-fold change in the heart It has become much stronger, and is divided into halves, which separate venous from arterial blood.

This is an example of dynamics which reveals a directionality on a large scale. Just as the solar system is an example of directionality on a great cosmic scale, so the circulatory system is one of a great biological scale. At the lower end of the series, as presented in this study, the two characteristic features are manyness—of parallel arches—and weakness—of pump or generator As we trace the evolution of this system, we find that manyness gives way to oneness and that weakness gives way to strength In terms of these characteristics, it is evident as to what is meant by being on or off the line of evolution It is also evident as to what is meant by saying that a form is near to or far from the main line of evolution The greater the manyness of the system, the closer it is to the central trunk of the tree of evolution, at least as far as the organ system now under consideration is concerned The weakness of the pump is the same type of index. But life is an evolving system of principles, and as a consequence of this directionality of life forces, there has occurred a shift, and when we reach the aves and the mammals, it is expressed by strength of pump and the oneness of arch.

Nature is not divided against herself. Nature is not one-half mechanical and one-half teleological; nor is nature wholly mechanical in the sense of mechanical which would not permit the rôle of transient processes. What the impartial student of nature observes *is that everywhere there is a movement toward some kind of goal realization.*

Perhaps the best way to state the situation is to say that nature is a system that is entirely dynamical; that is, it is an infinitely complex system of processes which are transient in character. It is to be hoped that when the present series will have been completed through the presentation of the directionality of the skeletal, the muscular, the endocrine, and the neural systems, the dynamics which is the core of gestalt psychology will be seen in a much larger setting.

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The Journal of Genetic Psychology, 1941, 58, 247-254

THE DEVELOPMENT OF SPACE PERCEPTION
I. STEREOSCOPIC VISION IN PRESCHOOL CHILDREN*

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A. Introduction

In 1873 Spalding (4) in a paper entitled *Instinct, With Original Observations on Young Animals,* called into question the theory then extant that perception of distance and direction is empirical. Spalding reported on the early localizing reactions of chicks, turkeys, and pigs as well as the flying propensities of young swallows. From his observations he raised the following question:

> With regard to man, is there any reason to suppose that, unlike all other creatures, his mental constitution has to be, in the case of each individual, built up from the foundation out of the primitive elements of consciousness? Reason seems to me to be all the other way. The infant is helpless at birth for the same reason that the kitten or swallow is helpless—because of its physical immaturity, and I know of nothing to justify the contrary opinion, as held by some of our distinguished psychologists. (He was referring to Bain, Mill, and Helmholtz.) Why believe that the sparrow can pick up crumbs by instinct, but that man must learn to interpret his visual sensations and to chew his food? (5, p. 508)

Child psychologists in general have not been impressed by Spalding's argument. For example, Goodenough (3) in her book, *Developmental Psychology,* has this to say about the development of human space perception:

> Very early in life and without being aware that we are doing so, we learn to interpret this (binocular) difference in visual sensation in terms of tactual and muscular sensations we get from handling objects. . . . When we say the tree trunk *looks* rounded we mean only that the visual sensation has the quali-

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*Accepted for publication by Edmund S. Conklin of the Editorial Board, and received in the Editorial Office on December 6, 1939.

> ties that from infancy on we have learned to associate with objects that *feel* rounded. The infant at first lacks this experience and so even though his visual sensations may be exactly the same as ours, it does not have the same meaning for him that it has for us (pp 138-139)

The only experimental study with children which bears directly on this problem of the native versus the empirical origin of stereoscopic vision was reported by Harvey Carr in 1935 (2) Children between the ages of 2 years 5 months and 5 years were tested. The procedure was as follows First, two skeletal truncated cones were constructed out of small brass tubing. They were mounted in a horizontal position with the small circle of one and the large circle of the second directed toward the point of observation A third object was similarly constructed except that the two circles were placed in the same plane These three objects were placed side by side on a table, and viewed against a white background The subjects were thus presented with three objects that were exactly alike in all respects except that of relief

Stereoscopic diagrams of each of these three objects were then drawn, and these were successively presented to the children in a definite order by means of a stereoscope After some preliminary practice, the children were directed to identify what they saw in the stereoscope in terms of one of these objects. The performance of four children whose ages ranged from 2 years 5 months to 2 years 8 months did not exceed chance expectation The 11 youngsters whose ages ranged from 3 years 1 month to 5 years exceeded chance, but did not make perfect scores. The percentage of incorrect judgments was 21 per cent for the three-year olds, 18 per cent for the four-year-olds, and one per cent for the five-year-olds From these results Carr concluded that "the experiment thus gives no decisive answer as to the innate or empirical origin of the stereoscopic mechanism We merely know that it is functionally present at three years and thereafter it improves to some extent with age" (2, p. 243)

In view of the fact that the children in Carr's experiment not only had to focus the stereoscope, but also to make rather complex judgments between the stereoscopic views and the models, the "improvement with age" which Carr mentions may have been an experimental artifact.

In our experiment we have attempted to achieve a more or less natural setting where the child *could* reveal through his spontaneous reactions the presence or absence of stereoscopic vision. In this paper we have arbitrarily confined our discussion to a description of the experimental technique, and to a brief report of the performance of children whose ages ranged from two to six years.

B. Apparatus and Procedure

Figure 1 presents a schematic diagram of a stereoly-polaroid system for projecting tridimensional pictures.[1] *A* is a 300-watt, Leitz still projector, *B* is a prismatic attachment which fits over the projector lens and splits the light from the projector into two beams, *C* indicates filters in front of the prisms that polarize the two beams, one vertically, the other horizontally, and *D* is a pneumatically operated blind so placed that as it is elevated it obliterates one beam. An opaque window shade, *E*, is at the top of a ground glass screen, *F*, which measures 24 by 36 inches. *G* represents polarized images on the screen, and *H* is a ruled piece of cardboard showing distances from the screen. *I* is a child viewing the polarized images through polarized spectacles. The equipment was set up in a dark room, and the projector was concealed from the child by suitable curtains.

Figure 2 shows the stereographic slide of a doll which was photographed in natural color and projected on the ground glass screen. The left-hand and right-hand images were seen by the left and right eyes, respectively, by virtue of the polarizing process. The disparity of the two images is such that in stereoscopic vision an adult would localize the doll as being about midway between himself and the screen.

A group of 23 youngsters were tested. The age composition of the group was 6 two-year-olds, 4 three-year-olds, 7 four-year-olds, 4 five-year-olds, and 2 six-year-olds. Each child was called for at his home or the nursery school and on the way to the psychology department rapport was established by conversing freely with the youngster. Upon arrival at the psychological laboratory, the child was escorted into the experimental dark room and seated on a small chair approximately 20 inches in front of the ground glass screen. With the child's help, the polarized spectacles were put on

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[1] For a more detailed description of this apparatus, see (1).

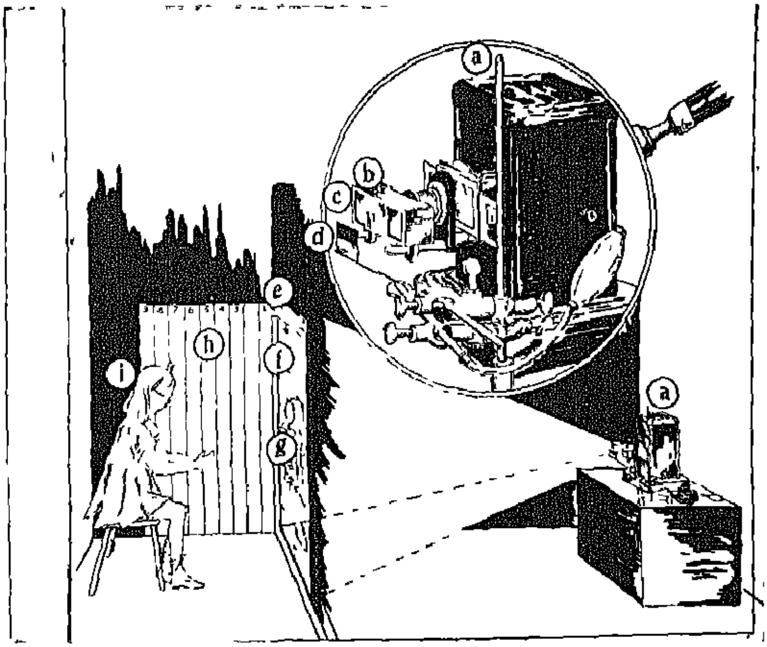

FIGURE 1

Schematic Diagram of Apparatus

a Leitz projector for showing 2"x2" slides
b Stereoly attachment which splits light from projector into two beams
c Polaroid screens that polarize the two beams, one vertically, the other horizontally
d Pneumatically operated blind
e Window shade
f Ground glass screen.
g Polarized images thrown by projector Cf., Figure 2
h Ruled cardboard indicating distances from screen
i Child viewing the polarized images through polarized spectacles The phenomenal position of the doll is revealed by the reaching responses of the child as explained in the text

Then admonishing the child to watch for the dolly, the overhead lights were snapped off and simultaneously the window shade was raised, revealing the double image of the doll For an adult, of course, the double images fused, producing a stereoscopic effect, an illusion of the doll's being held approximately 10 inches in front of the screen

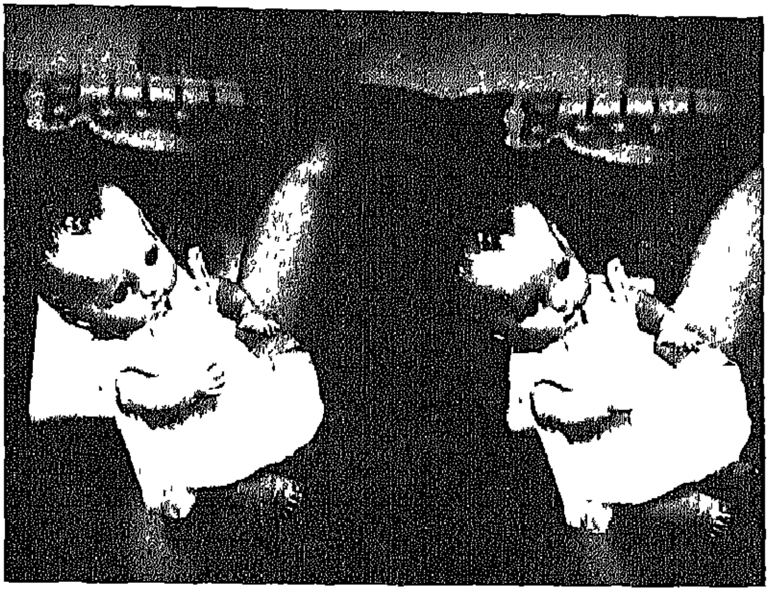

FIGURE 2

Stereographic Slide

The right and left halves of the stereograph were seen by the right and left eyes, respectively, using polarized light

The child was now queried with a number of guarded questions such as, *"Isn't that a nice dolly?"*, *"Do you see the dolly's eyes?"*, *"Do you see the dolly's nose?"*, and *"Doesn't the dolly have a pretty dress?"* After this short discussion of the doll's attributes, the child was asked, *"Would you like to touch the dolly?"* or *"Would you like to hold the dolly?"* Needless to say, the aggressive youngsters did not wait for permission to reach for and to exploit the ethereal doll. As the child reached for the doll, the approximate point of manual localization was noted, using the ruled cardboard as an aid in judging.

The next step was to block out one image with the pneumatically controlled blind and again to ask the child if he would like to touch the dolly. The localization of this image similarly was recorded. Following this regular procedure, the double and single images were presented several times in order to verify the first records. All chance remarks of the child were written down.

C. RESULTS

The spontaneous comments of the children clearly indicate that the stereoscopic illusion took on the appearance of reality. Here are some typical remarks which children, selected from each age level, made when the stereoscopic images of the doll were exposed to them:

Boy, age 6-2, when asked if he thought he could touch the doll replied, *"Sure, I can!"* He extended his hand to within about 10 inches of the screen and, after searching with his fingers for a few seconds exclaimed, *"Say, it must be magic; I can't feel it."*

Girl, age 5 years. Spontaneously explored the thin air with such vigor that the experimenter laughed out loud. Unperturbed, the youngster stated, *"I'm going to get the doll,"* and pulled the chair as close to the screen as she could, which brought her eyes to a distance about eight inches from the screen. She slowly moved her right hand back and forth between her face and the screen and still was not convinced that the doll was illusory.

Boy, age 5-9. *"I'm touching her nose but I can't feel her. Why can't I?"*

Girl, age 4-11. *"I put my hand through it* (the doll)."

Boy, age 3-3. Actively exploring 10 inches in front of the screen, *"I can't touch it."*

The two-year-olds were either too young or too nonplussed to discuss the illusion. However, the reaching reactions clearly revealed that all the children must have perceived the doll as a tridimensional figure. Each child, irrespective of his age, localized the doll as being in the area 10-12 inches in front of the screen. If binocular cues of depth were not being used, the child would have localized the doll at the plane of the screen. As a matter of fact, when the experimenter obliterated one of the stereoscopic (double) images, all but three of the children immediately indicated the true position of the doll by actually touching the screen. Of the three youngsters who did not touch the screen, two were two-year-old boys. One merely pointed and said, *"Way over there is dolly,"* while the other, after reaching for the illusory doll, turned away from the screen and whimpered, *"I'm scared!"* The third child was a four-year-old girl who, through apparent timidity, was reluctant to lean forward and extend her hand. That she observed a difference between the bidimensional and tridimensional pictures, however, was shown by her observation that *"Dolly goes* *in the house,*" and "*Now it comes out*." She said this several times as the pictures were changed back and forth. Apparently the screen and blind were mistaken for the window of a house.

With the obliteration of one image an adult wearing polarized spectacles often would perceive the remaining monocular image as lingering in front of the screen. Then it would recede rather abruptly to the plane of the screen and concomitantly would increase in size. These changes also were noticed by the youngsters, and a variety of spontaneous remarks, of which the following are representative, were made. Girl, age 5-1, "*Now it's little. Now it's big. Whew, it's big!*" Girl, 4-6, "*Why doesn't the dolly get bigger again?*" Girl, 3-9, "*Now it's bigger. Now she comes back.*" Boy, 3-4, "*It goes back.*"

The illusory movement of the doll back and forth undoubtedly was due to differences in the localization of the doll in binocular and monocular vision. In the former case it was seen approximately 10 inches in front of the screen, while in the latter instance it was localized at the plane of the screen. The changes in phenomenal size probably can be attributed to the factor of ocular convergence. The doll, when seen stereoscopically, was judged as nearer and perforce required more convergence than the doll perceived at the plane of the screen. It is well known in experimental psychology that if two similar objects produce equal areas of retinal stimulation but unequal degrees of convergence, the object with the lesser convergence is usually judged as being the larger and farther away (6, pp. 674-680).

In summary, our results show (*a*) that children as young as two years have well developed stereoscopic vision, and (*b*) that ocular convergence probably is an important and perfected cue for the judgment of size by preschool children. There is no evidence to substantiate the dual implication of Carr's results that the stereoscopic mechanism is first functional at about the age of three years, and that thereafter it improves to some extent with age. As for the question of the innate versus the empirical origin of the stereoscopic mechanism, it is clear that an answer, if it is to be found, must be sought in the study of the visual perception of infants and animals.

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The Journal of Genetic Psychology, 1941, 58, 255-261

CHANGES OCCURRING IN THE SERIAL REPRODUCTION OF VERBALLY PERCEIVED MATERIALS*

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A. INTRODUCTORY

The present study has two purposes: first, to report the ways in which the reproduction of verbally presented prose materials varies from the original, not during a considerable lapse of time, but rather under the conditions of seriality—passing the material from person to person, and secondly, to examine the effect of a "mental set" (*aufgabe*) upon the directional changes of the reproductions.

This experiment was suggested by studies on ideational change which have been reported by Wulf (10), Gibson (6), and Allport (1). These investigators worked with geometric designs. After securing a number of reproductions, they analyzed the variances from the originals and classified the changes that took place. Wulf emphasized the presence of (*a*) levelling or omission, i.e., the toning down or weakening of certain characteristics, and (*b*) sharpening or emphasis of certain other characteristics or peculiarities. Gibson analyzed the changes in terms of (*a*) object assimilation, or change toward the familiar thing, (*b*) verbal analysis, (*c*) figure assimilation, (*d*) completion and disintegration, and (*e*) rectilinearity. Allport reported that (*a*) the excellence of reproductions decreased with the number of reproductions, (*b*) the passages became progressively smaller in size, (*c*) displacements occurred, (*d*) also assimilations, and (*e*) omissions.

Kirkpatrick (7) and Lewis (8) have used prose passages as learning material while employing the method of lapse of time. Kirkpatrick found (*a*) condensation, (*b*) expansion and filling in of gaps, (*c*) increasing plausibility, and (*d*) some evidence for changes in hedonic feeling tones. Lewis concluded that the most obvious change was the relative lack of dependence of both gist and detail of the reproductions upon particular words or sentence structures. The persistence occurring, then, is essentially a persistence of organized wholes.

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*Received in the Editorial Office on December 11, 1939.

It is, however, Bartlett's approach to the problem which is most relevant to the present experiment. Bartlett (3), using prose passages in seriality, found the changes to be mainly those of (*a*) simplification, due to the gradual construction of a more coherent whole, and to the changing of the unfamiliar into some more familiar counterparts, (*b*) rationalization, which may involve considerable elaboration; and (*c*) a tendency for certain incidents to become dominant so that all others are grouped about them An experimental examination of these findings will be undertaken in Experiment I, below

The method utilized in the second part of this study was suggested by an experiment of Carmichael, Hogan, and Walter (5) on the effect of "mental set" on the reproductions of geometric figures Their study clearly demonstrated the effect of prior experience on the reproduction of such forms.

B Experimental Procedures and Results

1. *Experiment I*

The first experiment was a partial repetition of Bartlett's study, using the same passage that he used *The Boy Who Tried to Outwit His Father* (3, p 129) Bartlett's procedure was modified slightly in that the passage was read to the subjects twice in succession instead of allowing them to read it themselves Also, where Bartlett allowed a free interval of 15-30 minutes before reproduction was called for, our subjects were limited to 15 minutes, during which they looked at magazine pictures. The serial reproductions were obtained as follows the first person in the series heard the original passage read, the second person was read the reproduction of the first person, etc Two series of 20 subjects each (Barnard College students) were used in this experiment.

The results were analyzed by dividing the original passage into separate elements, each representing a "unit" of thought. Table 1 presents a sample of the analytical tables that were thus constructed

By tracing these elements through each reproduction in the series, it was possible to determine the point at which the element was dropped or significantly changed, as well as the character of the change.

Analysis of the results showed that the changes taking place in this verbally presented material are, in general, in agreement with

TABLE 1

Showing the Dropping Out of Parts of the Story of *The Boy Who Tried to Outwit His Father*

Each point of dropping out represents the serial number of the reproduction in which that particular element disappeared

Original thought	Point of dropping in Series I	 Series II	Comments
A son said to his father one day	7	12	
"I will hide and you will not be able to find me"	8	10	
The father replied	4	10	
Etc			

those of Bartlett, Wulf, and Gibson. Changes classifiable as "simplification" were first of all quantitative omission. The first reproduction was 201 words in length and the 20th, in the same series was 55 words, roughly one-fourth of the first. In the other series the first reproduction was 179 words and the 20th, 71 words, less than half as much as the first. Secondly, there were certain qualitative changes. Bartlett has said that the omissions occurring are omissions of material that appears irrelevant. It was found here, however, that there is little or no correlation between the order of dropping the elements, whether important or irrelevant. While this difference between Bartlett's results and those of the present experiment cannot be simply explained, the lack of correlation may be due in part at least to differences in the nature of the groups used. And, of course, there is no rigid criterion of relevance which can be applied here to ascertain the "true" correlation.

The task is further complicated because there often occurred the fusion of two separate elements. This is essentially Bartlett's factor of "cohesion", it appears to be a factor of prime importance in condensations.

Omissions may be due in part to the experience of the college subjects in taking class lecture notes. Condensations in such activity are often achieved by running separate thought units together into a single passage.

Another cause for omission that Bartlett gives is the changing of the unfamiliar into some more familiar counterpart. Instances of this were found, although it seemed that the unfamiliar might either be levelled or sharpened (to use Wulf's terms), depending upon its intrinsic attention-getting value.

Length of the passage to be reproduced must also be added to the list of causes of omissions

Changes which Bartlett terms changes toward rationalization were noted. One illustration of this is shown in the following successive reproductions

> The boy's father gave him three peanuts One he ate, one he saved, and one he gave to a fellow. The dog ate the snake and the snake fell in the lake and was swallowed by a fish

This passage became, in the next reproduction·

> The boy's father gave him three peanuts One he ate, one he kept, and one he gave to a fellow The fellow dropped his and it was eaten by a snake

Thus the incident is shaped to make a more plausible (rational) sequence

In contrast to Bartlett's finding, moralizing as a factor making for changes was only slightly, if at all, present in these two series

The final change noted by Bartlett is that of transposition of words and phrases, with a tendency for certain groups to be dominant, with others grouped about them It is evident, however, that as a passage becomes shorter during the course of reproductions, each part will consequently assume a more nearly equal value, and the passage will be retained more accurately

2 *Experiment II*

In this experiment the method of serial reproduction was retained but a specific "mental set" was provided, for the purposes of investigating directional changes that might be induced thereby Three passages of anthropological material were constructed, which will be designated as Passages *A*, *B*, and *C* The *A* passage is entitled *The making of clay pots* and is a free adaptation of a story found in Bushman Folklore (4) The *B* passage, entitled *Pottery and religion*, was adapted from Rattray's *Religion and Art in Ashanti* (9), and from an article by Ashmead in the *American Anthropologist* (2) The *A* and *B* passages are the "mental set" passages Passage *C*, the "test" passage, was constructed by taking three thought elements from each of the other two passages and placing them in a passage of material not to be found in either "mental set" passage, but pertaining to religion and pottery, thus serving as a matrix to hold the otherwise discrete elements from the *A* and *B* passages together. These elements were placed in the *C* passage in such a way that any influence of primacy and recency would be minimized. The order was *B*, *A*, *A*, *B*, *B*, *A*.

A subject was given one of the "mental set" passages to read for five minutes. Then Passage *C* (or a previous rendition of Passage *C*, depending on the subject's position in the series) was read twice to the subject by the experimenter. A written reproduction was then immediately called for.

Barnard College students and Union Junior College (N. J.) students served as subjects, totalling two groups of boys and two groups of girls. A group here consists of a series of 10 persons with the *A* set, 10 with the *B* set, and a control series of 10 persons with no specific set. The control subjects merely were read the *C* passage (or reproduction of it) twice, and were then asked to make a reproduction of it.

The results show a definite influence of the "mental set" passages on the nature of the reproductions secured. In Table 2 is shown the average place in the series of reproductions where *A* items and *B* items were dropped. It will be seen from this table that the effect of the *A* set on reproductions is unquestionable. For both groups of boys and girls, the series with *A* set retain *A* items considerably longer in the series than they do the *B* items. The boys seem to be somewhat more influenced by the *A* set than are the girls.

However, it should be noted that in two series with Set *B*, the *A* items were retained somewhat longer in the series than were the *B* items. In another series there is equality, and in the fourth series, a slight difference in favor of the *B* items. The results of the control series indicate clearly that in the absence of prior "mental set" material, *A* and *B* items are retained equally well. Thus it seems evident that Set *B* had relatively little effect on differential retention, resembling the control series results much more closely than it did *A* set results.

These findings would seem to indicate that in practice the *B* passage, which was intended to be equal in attention-getting value to the *A* passage, proved to be less potent in influencing reproductions than the *A* passage, or that in Passage *C* the *A* items selected stood out more clearly somehow than the *B* items, due to a greater strikingness of the items themselves. If so, this is a factor which appeared

TABLE 2

SHOWS THE AVERAGE REPRODUCTION IN WHICH THE CRITICAL ITEMS OF EITHER MENTAL SET *A* OR *B* HAVE BEEN ELIMINATED (PLOTTED ALONG A CONTINUUM OF 1-10)

There are two groups of boys and girls. The last part of this table represents the total averages of the two groups of girls and the two groups of boys.

Series with mental set	Average of dropping of *A* items	Average of dropping of *B* items
Girls		
A	6.3	2.3
B	4.6	4.0
Control	3.3	3.3
A	2.33	3.0
B	3.66	4.0
Control	3.0	3.0
Boys		
A	5.0	1.66
B	2.33	2.33
Control	1.0	1.33
A	3.0	1.0
B	3.0	2.0
Control	1.33	1.0
	Total averages	
Girls		
A	4.31	2.65
B	4.13	4.0
Control	3.15	3.15
Boys		
A	4.0	1.33
B	2.66	2.16
Control	1.16	1.16

despite precautions to make the two sets apparently equal in value before the experiment.

The effects from the *A* set series, however, are sufficient to demonstrate the effect of this prior experience on the differential retention of the various critical parts of the *C* passage. Having just read a passage discussing the making of clay pots, subjects are more impressed (as measured by the reproductions given) by the pot-making elements in a subsequent selection which deals with religious items and pot-making items.

As further illustration of the effect of the *A* passage there were in the reproductions instances of "reversions" to the original mental set material, in the absence of such an item in the preceding reproduction.

A further finding is a tendency toward misrepresentation of statements from the other "mental set" passage (i.e., a misrepresentation of *B* items by *A* subjects, and vice versa). There was also a shift in the order of events of the passage, which differed for the *A* and *B* subjects. Those with the A set (*The making of clay pots*) tended to shift the technicalities of the making of clay pots forward to the beginning of their reproductions. Subjects with the *B* set kept the order fairly well but tended to cluster the symbolic material at the beginning and end of the passage, with the pottery making near the middle. Such shifts indicate that the "mental set" had a heightening effect on the corresponding materials in the *C* passage, causing them to be placed in more intrinsically "vivid" parts of the reproductions.

3. *Experiment III*

In order to provide a corroboration of the results of Experiment II, it was decided to gather comparable data on the reproductions of a larger number of subjects, using the same general procedures, but not the method of seriality. Forty-one Barnard College students were used as subjects, divided into three groups, as follows: *A* set, 13; *B* set, 14; Control, 14.

Each student was given either the *A* passage or the *B* passage to read, or, for the control group, an irrelevant task (word-building) for a five-minute period. Then the *C* passage was read twice through by the experimenter, and reproductions immediately called for.

Table 3 presents the summarized results of this experiment. It is seen again that *A* items stick with the *A* group much longer than *B* items do, and also that the *B* group retain *A* items slightly longer

TABLE 3

THE AVERAGE NUMBER OF PERSONS WHO RETAINED THE CRITICAL ITEMS (PLOTTED ALONG A CONTINUUM)

	Presence of critical elements Averages	
Series with mental set	Average retention of *A* items	Average retention of *B* items
A	12.3	5.6
B	9.6	9.0
C	10.3	8.3

than they do *B* items These results agree with the results of Experiment II The results for the *C* group, however, are more clearly in favor of the *A* items than they were in Experiment II, thus providing further evidence that the *A* items must have possessed greater retention value than the *B* items

The fact that the *A* group retains *A* items better than the control group does, and that the *B* group retains *B* items better than the control group does, indicates that, despite non-equality in the perceptive values of the two sets of items, both the *A* passage and the *B* passage were differentially effective in shaping the reproductions of the *C* passage.

As in Experiment II, this experiment revealed (*a*) reversions to "mental set" items, (*b*) misstatements of the other "set" items; (*c*) changes in order, and (*d*) additions of "extra" elements by the control group

C Discussion and Conclusions

The serial reproductions obtained without a particular mental set show that the changes occurring in the reproductions of auditorially presented prose materials can be compared to the changes occurring in the reproduction of visually presented geometrical forms.

In Wulf's terminology, levelling and sharpening were clearly evidenced in the present material Levelling can be defined as the dropping out early in the series of certain (minor) elements, and the instability in form of certain others Sharpening, as applied to the prose material, refers to the retention and even heightening of certain ideas over and above the original

As Allport found in the visual field, there was also found here (*a*) a decrease in excellence with the number of reproductions; (*b*) progressive alterations toward smaller size; (*c*) displacements, (*d*) assimilations, and (*e*) omissions In our results we have tended to group several of Allport's classifications under a single heading, for example, simplification has included such things as omission, assimilation, some alterations in size, and decrease in excellence Transposition of words or phrases seems to fall into Allport's category of displacement

Gibson's results are described in terms which seem to be most pertinent to visual geometrical material, but his classifications of changes toward the more familiar, and changes described as completion and disintegration are clearly relevant to the changes observed in the present prose materials

Experiments II and III have shown that an enhancing effect on serial reproductions can be produced by providing a "mental set" before the reading of the test passage It may readily be granted that the set induced here is not quite the same thing that Carmichael, Hogan, and Walter (5) have reference to, since the subjects were not given explicit directions such as, *"You will now hear such and such items."* The reading of Passage *A* or *B* did, however, induce a certain readiness for that kind of material, and the results show that such a preliminary "mental set" does influence reproductions of verbal materials as well as reproductions of visual forms

It remains possible that, in reading aloud the test passages, the experimenter might have inadvertently affected the reproductions by differential stressing, etc This factor was realized and guarded against, and it is believed that it was reduced to a non-significant value.

Certain differences were found between results of boys and girls on this test Most noteworthy was the fact that in the control series the boys retained critical items for fewer reproductions than did the girls, irrespective of whether the girls were junior college or college students This result agrees with other findings indicating that girls usually make higher scores than boys in tasks involving verbal learning and memory However, post-experimental questioning revealed that the boys seemed to find the experimental materials less interesting than the girls did, and this factor may be quite sufficient to account for the sex discrepancies found

An analysis of the reproductions according to sex of the subject, with a view to uncovering possible differences in amount of effect exerted by the mental set passages (suggestibility?) revealed no differences between boys and girls in this respect

In conclusion, these results may be held to show that changes in the serial reproductions of verbally presented prose materials may be described according to the same principles used to describe changes in visually presented geometric forms, the two appear to have many features in common Further, the changes which occur in each can be affected by the induction of a "mental set" prior to presentation of the material

D Summary

The present study attempted (*a*) to investigate the ways in which serial reproductions of verbally presented material vary from the original, and (*b*) to study the effect of a "mental set" upon the direction of changes of the reproductions.

In Experiment I (serial reproductions with no specific set) changes were found which could be described in the terms which have been used to describe changes in the reproductions of geometric forms

In Experiment II, it was found that the reading of a "mental set" passage prior to hearing the test material read exerted a definite directive effect on the changes occurring in the reproductions given

These results were corroborated and extended in Experiment III which repeated Experiment II with a larger number of subjects and in the absence of seriality

The general conclusion was reached that the results obtained indicate that the reproductions of verbal prose materials have much in common with the reproductions of geometric materials, and are describable in terms of the same general principles.

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The Journal of Genetic Psychology, 1941, 58, 265-288

VALIDITY OF MENTAL TESTS FOR YOUNG CHILDREN*

Board of Education, Philadelphia

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A. INTRODUCTION

Mental tests for the preschool ages are among the newer developments in the field of clinical psychology. It is not surprising that there is more scepticism in regard to them and that for the prediction of later mental capacity, less reliance has been placed on their validity than is true with tests given at the school ages. For those who are less familiar with small children, it is not hard to understand the doubts which arise as to the difficulty in making satisfactory, controlled and reliable observations. But to the clinician who has developed a familiarity and technique with little children, these ages present essentially the same general psychological characteristics and problems of all ages, with the same gradations, variations and complexities. It is true, however, that more of the potentialities of preschool youngsters are obscured, and this being recognized, one would expect a proportionately lower validity figure.

The problem with which I have been concerned is this: How valid are test results for young children? Is a feebleminded individual recognizable at six months, at one year, or not until six years or even later? Is a person of collegiate caliber discernible as early as two years? Our problem is, in general, how early in the life history of an individual can we establish an *IQ* which will prove relatively stable? If we study a baby at one or at two years, will our diagnosis be the same at school entrance, at graduation from high school, and at adulthood? What is the predictability of mental test results for babies and what data can the psychologist contribute at this point to answer these questions?

In the clinical research laboratory emphasis has been given to comparative studies and it is this type of investigation that has been extensively reported in the literature. The results of one scale have been correlated with those of another for approximately the same

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*Received in the Editorial Office on December 11, 1939.

age group I have been concerned with a somewhat different problem

I began my own research in the development of preschool tests before there were any publications on the subject except the Kuhlmann data of 1922 in *The Handbook of Mental Tests* I was acting as consulting psychologist for two social agencies which were assuming the responsibility of placing babies for legal adoption My function in that program was to determine the mental level of the babies through the use of every tool available, in order to make diagnoses which would be as accurate as possible I was not concerned with investigating the reliability or validity of the test scales employed My research interests grew out of the desire on the part of the child placing agencies to match the intelligence level of the child adopted, with that of the foster parents—a practical problem dependent for its solution upon an early diagnosis and its relative stability Consequently, one of my chief concerns has been the comparison between a diagnosis at one, two, or three years with later estimates as the child became older.

The field was searched thoughtfully to select test items which seemed to give as complete a picture of the child as was then possible As time and research added new tools, the older methods became pretty incomplete and inadequate New scales, such as the Gesell and Merrill-Palmer were welcomed to supplement responses which could be obtained from a series of performance tests which I was standardizing My approach was to evaluate the results from various tests against a background of family history, individual development, and environmental facts On the basis of all the assembled data, a developmental quotient was derived The *DQ* follows the same general principles as the commonly used *IQ* and accepts the principle of the validity of the norm idea

As Gesell so aptly puts it in his *Infant Behavior*

> A developmental norm is a specification of a behavior pattern or of a behavior characteristic made to serve as a criterion or as a standard of comparison in the scrutiny of a behavior status The primary use of the norm is to identify and to characterize observed behavior forms Strictly speaking a norm is not a unit of measurement It represents a positional value rather than an absolute value in a calibrated scale of equal units A norm is used as a critical device for discovering resemblances and differences Accurate comparison by means of

> a systematic frame of reference approximates the precision of measurement.

With this general statement of my problem I should like to present a description of the group whom I studied, the test material which was used, and the results which were obtained.

B. The Group Studied

The study includes 250 individuals. Fourteen per cent were "own children" who had always lived with their parents. The other 86 per cent were foster children under the care of the Philadelphia Children's Bureau and the Pennsylvania Children's Aid Society. Thus the bulk of the youngsters had lived in two or more environments. Some of the babies came, directly on discharge from the hospital, to the social agency, at an age varying from 10 days to several months. Some came to the agency after a period with their own families, which usually was an unsatisfactory arrangement or it would have continued. Still others had had a prior institutional placement. This complete change in environment in most cases is an important factor to keep in mind. A recent study, such as Burks', has estimated that as much as 20 *IQ* points can be attributable to extreme environmental differences, and one wonders therefore whether any distortion to the validity correlations may have been caused by the environmental changes which many of the children in this group were subjected to at such an early age.

At the time of the initial psychological study the ages of the children were as given in Table 1.

TABLE 1

Under 12 months	25 cases
From 12 to 23 months	79 cases
From 24 to 35 months	80 cases
From 36 to 47 months	66 cases
Total	250 cases

No child was examined psychologically who had not had a complete physical examination, the findings of which were available. If a child was in poor or questionable health, the mental test was usually deferred, or if given, allowance was made for the reported condition.

Usually it was possible to confer with the person who cared for the baby and who knew best the details of his day by day behavior, as well as his developmental record This means that for most of the children tested, there was a fairly complete physical and developmental record and, where procurable, significant family history

At the time of the last examination the ages were as given in Table 2

TABLE 2

5 years	72
6 years	58
7 years	44
8 years	31
9 years	20
10 years	15
11 years	5
12 years	2
13 years	3
Total	250 cases

The modal age was five years, the median age six years Fifty-two per cent of the children were five and six years old, and 48 per cent were between seven and thirteen years.

As to the general intelligence level of the 250 children studied, they represent a fairly normal scatter with a median *IQ* of 96 The *IQ* distribution at the time of the last test is shown in Table 3

TABLE 3

100 percentile	151
99 percentile	142
90 percentile	119
80 percentile	111
70 percentile	106
60 percentile	101
50 percentile	96
40 percentile	91
30 percentile	86
20 percentile	81
10 percentile	75
1 percentile	50
0 percentile	42
Total	250 cases

C The Testing Procedure

The study represents 427 correlations and about 700 examinations extending over a period of approximately 12 years From this experience it is believed that most small children react more naturally in the setting of their own homes, with their mother or foster mother present Therefore practically all the examinations were planned for in the children's homes

Small children usually are not more difficult to test than older ones, but to obtain the best possible results and the greatest display of their potentialities, my experience has suggested that special familiarity with this age group must be built up and modified techniques used By the time a child reaches six or beginning school age, he has been subjected to a considerable number of disciplinary experiences in life and therefore will usually respond, without much suggestion, to controlled psychological conditions He will do things asked of him, even if he has no special interest in the task For the one-, two-, or three-year-old, this cannot be said Life to the very young child is, except perhaps in food and toilet situations, pretty much an existence which is relatively spontaneous and uninhibited To secure the greatest cooperation in finding out what little children can do with test material, I believe we must therefore, as nearly as possible, duplicate their play situations If the conditions set up by the psychologist are too artificial or strange, restrictions and inhibitions are imposed which may very much block and alter the reactions desired

As with all examinees, but with this group even more so, is the need to establish a rapport between the psychologist and the child A friendly contact must be secured, cautiously and on the child's own terms, An interest must be aroused in the "bag of toys" which have been brought along to be played with Babies have a casual but very positive way of ignoring and dismissing things which do not interest them They will not accept an adult's request to do a test unless there is a desire to do so This being the general interest pattern of the young child, one must use a flexibility in procedure There can be no stereotyped order in presenting the material, though usually it is more successful to begin with performance or block material and to introduce verbal items indirectly or when a still greater familiarity has been established. Initial shyness does not so much effect response to concrete material, but may cause completely negative responses with verbal tests such as naming objects or pictures, repeating memory material, etc

Young children have a relatively short attention span which also at times necessitates a modification in the presentation of the material

They are at times highly distractible so that tests have to be rapidly introjected at opportune moments and interspersed with play of their own selection. Whims must be given consideration and desires met so that friendly relations are sustained, but always with the end result of a diagnosis in mind. Patience is always necessary. At times material may be quite willingly responded to on re-presentation which was at first refused.

The very active child presents probably the most difficult situation. The examiner must always be one step ahead, anticipating his behavior and seeing that material is continuously supplied in order to keep the situation going in the desired channels.

The simplest material should always be given first so that no failure situation is experienced until it is inevitable. Even though failing, the child must be encouraged and praised. Encouragement should be given indirectly by one's attitude rather than by any actual help, or else results cannot be comparable to the established norms.

Another situation which must be held in mind is the importance of manifest interest and recognition of the fact that failure to do a test, especially for the child under two years, does not necessarily mean inability to do it. Often further study must determine what was inability and what was disinterest.

With patience, ingenuity, and encouragement, and if necessary, indirect presentation of material, I have found emotional resistance and non-conformity rather infrequent. With the comparatively large amount of standardized material available, enough satisfactory responses usually are obtained so that a correct diagnosis is possible.

For children under one year the complete Gesell material was used. At times for verification of data in certain studies, the Buhler or Linfert-Hierholzer scales were added.

For the group from 12 to 23 months, in addition to the Gesell items, the *Three Disc* and *Three Figure Formboards* and Wallin Pegboards were used, also the Stutsman *Sixteen-Cube Test* and some block building problems. At 24 months color matching was added, and towards 30 months, if earlier success indicated, the Witmer *Formboard*. Also in many cases certain selected Stutsman tests were given, chiefly the drawing tests, the *Mare and Foal, Nest of Cubes,* and block building. The Binet Scale was given to children from 30 months on, but was not found to be very helpful or reliable. Thus from Gesell were selected norms essentially for an evaluation of motor and language development, and the performance material was selected chiefly from the scales of Stutsman and Hallowell Each of these test items can be separately evaluated by the norm value for different age groups, and the sum of the norms can be averaged for an approximate developmental quotient The *DQ*, a numerical rating, is further weighted in light of developmental, medical, habit, and environmental data

I believe however that no diagnosis or *DQ* can be made on the quantitative findings alone, but that mental growth must be studied equally from the qualitative aspects of a performance At times it is the quality of response which chiefly determines what the given diagnosis should be Babies even a few months old differ significantly from each other, not only in their actual accomplishment but in the attitudes which they show towards people and objects in their surroundings There can be observed a significant contrast between an intent, alert manner and a vague, disinterested one This is noticeable in the way infants will fixate on the simplest objects When a baby is older and is reaching for and handling toys we can see persistent and sustained attention as contrasted with aimless, distractible responses Still later, chiefly from about 18 to 24 months, the more normal children will begin to use toys in a purposeful way Banging, throwing around, and aimless play should be supplanted by play with definite ideational content back of it Complexity and variety of response are both maturational and experiential traits, and it is the superior child who earliest gives the greatest indication of these

One of the most marked variations in response at 12, at 16, and at 18 months is the difference shown in spread of attention A very simple test such as the *Three-Disc Formboard* offers an excellent medium for this to be demonstrated There is a definite progression of response from complete concentration on just one single block, as if no more existed, to an inclusive grasp of the entire board with consequent and immediate replacing of all three blocks This qualitative trait of distribution of attention without doubt indicates a psychological maturity which becomes increasingly more apparent, more developed and more important with age increase From my experience it has been shown that superior children display this wider perspective on problems considerably earlier than retarded ones, and that learning thus becomes correspondingly speeded up as more can be absorbed in a unitary perception

Similarly, motor control and coordination are qualitatively and differentially developed at various points along the growth scale. To use another illustration, one of the most important qualitative aspects of behavior response is discriminability. No matter how bright the baby may be, there is a point below which this capacity cannot be demonstrated. Discrimination seems to be definitely more a maturational than an experiential trait. Learning to recognize various people's faces and voices is one of the first evidences of the trait. Later it can be more objectively and systematically studied in distinctive response to a round and to a square block, or to a red and to a yellow cube. Material of this sort lends itself to differentiation between trial and error response and correctly discerned responses, and is something which quantitative results in themselves cannot distinguish.

The numerical *DQ* used in this study to describe a child's development at a particular age, is therefore, primarily the averaged result from various selected test items, but it is weighted further by qualitative responses and by information concerning maturational development, habit data, medical findings, family history, and environmental opportunities.

On the final study each child was given the full Stanford-Binet Scale of 1916. In addition performance tests were used—the Witmer *Formboard*, and the *Two-Figure*, *Five-Figure*, *Casuist*, *Gwyn*, *Diagonal*, Healy *A* and Healy *B* formboards of the Pintner-Patterson *Scale*. From these tests a Binet *IQ*, which is essentially a verbal rating, was secured, and also what I have descriptively called a *CQ* or combined quotient. This *CQ* was obtained by calculating the average of the percentiles made on the performance tests and combining it with the Binet *IQ*.

D. The Results of Retests

To test the validity of the diagnoses made on 250 children under four years of age, statistical comparisons were made between the *DQ* as previously described and the Binet *IQ* secured at school age. The *DQ* was also compared with the *CQ* of the Binet and Pintner-Patterson performance tests. To obtain correlations the product-moment formula was employed,

$$r = \frac{\Sigma xy/n - dxdy}{\sigma x \sigma y}$$

Since there were only 25 children tested under one year, correlations did not seem warranted for this small group. This group was retested the following year and was considered with 79 new cases secured at 12 to 23 months, making 104 cases. Each subsequent age group included some individuals who had been previously tested. The correlations are therefore on 427 sets of results and about 700 examinations (Table 4).

TABLE 4

CORRELATIONS OF *DQ* AND *IQ* AND OF *DQ* AND *CQ*

Age range	No. cases	Ratings used	Correlations	*PE* of estimate
12-23 mos	104	*DQ* and *IQ*	.668±.036	8.432
		DQ and *CQ*	.659±.038	7.918
24-35 mos	150	*DQ* and *IQ*	.798±.019	6.989
		DQ and *CQ*	.777±.022	4.749
36-47 mos	173	*DQ* and *IQ*	.837±.015	5.861
		DQ and *CQ*	.938±.007	1.243

Inspection of the correlation table shows a progressive increase from .668 at one year, to .798 at two years, to .837 at three years. The correlations between the *DQ* and *CQ* are quite similar at one and two years, but are .938 at three years.

Amount of variation between tests is also reported by percentages so that the *IQ* can be shown as both positive and negative and in terms of the *IQ* itself (Table 5).

Similar increase in *IQ* stability as the ages increase is indicated

TABLE 5

IQ CHANGES

	Age range				Own children
	4-11 mos	12-23 mos	24-35 mos	36-47 mos	
Range of *IQ* change	32 to —23	37 to —38	38 to —33	31 to —21	31 to —20
Median *IQ* change	+10	+10	+6	+3	+7
Mean *IQ* change	15	12.1	9.7	7.9	10.1
Plus or minus 0-5 pts	*12%*	*32%*	*40%*	*53%*	*36%*
Plus 6-10 "	24	16	19	17	14
Minus 6-10 "	8	11	9	9	8
Plus or minus 6-10 "	44	59	68	79	58
Plus 11-20 "	20	25	22	14	27
Minus 11-20 "	4	3	5	3	2
Plus 21-40 "	28	12	6	4	13
Minus 21-40 "	4	1	1		
No. Cases	25	104	150	173	36

by the table of *IQ* changes. Since it is generally determined that the probable error of estimate of a Binet *IQ* is approximately five points under average conditions, it seems that *IQ* variations of only more than five points are significant. However changes from 0 to 5 points, plus or minus, are reported. *IQ* changes of more than 10 points were 56 per cent under one year, 41 per cent at one to two years, 32 per cent at two to three years, and 21 per cent at three to four years. Changes of more than 20 points correspondingly decreased with age from 32 per cent under one year to four per cent at three years. The range of *IQ* change was practically unvaried at all preschool ages reported, but the average *IQ* change was 15 under one year, 12 at one to two years, 9.7 at two to three years, and 7.9 at three years.

It is also important to note that the changes were greater on the positive than on the negative side. Three to four times as many children raised their ratings as lowered them. Discussion of the probable reason for this will be taken up later (Table 6).

TABLE 6
PERCENTAGE RAISING AND LOWERING *IQ*

Age range	Percentage raising *IQ* 5 or more points	Percentage lowering *IQ* 5 or more points
4-11 mos.	72%	16%
12-23 mos.	53%	15%
24-35 mos.	46%	13%
36-47 mos.	31%	12%

Three groups have been selected for special comment—(*a*) own children, (*b*) superior children, and (*c*) inferior children.

(*a*). Unfortunately it was possible to retain contact over a period of years with only *36 children who had always lived with their parents*. Of this group 75 per cent had one or both parents who were college graduates. All had comfortable homes, there was no economic pressure, and in no case was there any known social or personality problem which was adversely affecting the child. It was felt that comparison with the other children in this study, children who had had changed surroundings, might contribute to our knowledge of the amount of variation attributable to environmental factors. Of this group, 20 children were 12 to 23 months old, 13 were two to three years old, and three were three to four years old.

From the table of *IQ* changes (Table 5), it is seen that the percentages of change very closely correspond with the changes of the entire 12- to 23-month group. Forty-two per cent varied on retest by more than 10 *IQ* points and the mean *IQ* change was 10 points. It seems therefore that relative stability of environment was not a sufficiently potent force in itself to give a high *IQ* constancy.

An analysis of the Binet *IQ* of these 36 own children is worth commenting on. The *IQ* range was 105 to 151, with the median and mean both 119. From additional data which will be presented, we see that superior children are not accurately diagnosed as early as inferior and normal children. Therefore it seems that the reason for the percentage of change shown in this group is probably a combination of both the age and superiority factors.

(*b*) It had been stated by a number of investigators that *superior children* are not recognized as early as inferior ones and to verify or contradict this, 33 superior youngsters were selected for analysis. My criterion of superior was, at the time of the last study, a Binet *IQ* of 115 or more, which is the upper 80 percentile group. The changes of this group are shown in Table 7.

TABLE 7

SUPERIOR CHILDREN—*DQ* AT TIME OF FIRST TEST

Age range	No. cases	*DQ* 90-99	100-104	105-114	115 and above
12-23 mos.	18	1	7	3	7
24-35 mos.	10	0	2	3	5
36-47 mos.	5	1	0	1	3
Total cases	33	2	9	7	15

Two cases, or six per cent, were diagnosed as lower average on the first test. Twenty-one per cent had been classified as upper average, but only 46 per cent had given results warranting a diagnosis of superior ability. The age at the time of the first test, whether one, two, or three years, did not seem to change the general situation, which from analysis of this group, would suggest that real superiority is not recognized with very young children in more than about half of the cases. I might also add that hesitancy in being too sure of diagnoses might somewhat account for failure to positively evaluate superiority until we have very positive evidence of it.

(*c*) Turning now to the *inferior group*, 18 children on their last test had been diagnosed as definitely feebleminded, and as such were committable to appropriate institutions. Eight were already in State Schools and the others were waiting for vacancies to occur Table 8 gives the diagnosis on the first study.

TABLE 8
INFERIOR CHILDREN—*DQ* AT TIME OF FIRST TEST

Age range	No cases	*DQ* below 70	70-74	75-79	80-85
12-23 mos	7	1	4	1	1
24-35 mos	7	2	5	0	0
36-47 mos	4	2	2	0	0
Total cases	18	5	11	1	1

Twenty-eight per cent were diagnosed as definitely feebleminded on the first test, 61 per cent were considered doubtful and possibly feebleminded, and 11 per cent were dull This indicates that subnormality was recognized early in all but a small group of the inferior children, and this 11 per cent were definitely below average

There is another group of children who might be mentioned here—those who gave very inferior results on initial studies, but improved markedly later. Some illustrations of this type will be given later.

E Discussion of *IQ* Changes

Foran and Nemzek have carefully analyzed a large number of studies reporting the results of retests given at various ages, with different scales, and with different size groups The studies do not all give comparable data, which limits the generalizations that might be made as to the amount of change expected when individuals are subjected to various tests at different time intervals. Foran states that "the correlations between successive tests vary between .80 and 95, depending to a considerable extent on the homogeneity . . . The largest deviations are observed in children below six years of age."

Nemzek, after an extensive analysis, concludes by saying, "results from studies concerning the constancy of the *IQ* present a high degree of consistency." The median correlation on 97 studies using the Binet scale was .832. His individuals were practically all, however, of at least kindergarten or school age

Freeman in *Individual Differences* discusses the constancy of mental growth and gives a concise statement of the problem. About

50 per cent of retested individuals will vary five points or less in either direction from the original quotient The chances that the *IQ* will vary by 10 points are about 1 in 5, that it will vary 15 points, 1 in 20

There is therefore fairly general agreement as to the changes which can be expected when individuals are subjected to retests Although most studies show considerable constancy, there is indication that in certain individual cases, extreme changes may be anticipated As was previously mentioned, the greatest number of retest studies have been with children beyond the preschool level Gesell, Wellman, and Cunningham have reported on some younger children. Gesell selected 90 cases, but on final study they were only four years of age His data showed that 80 per cent made a developmental rating on the final examination which corresponded with the first clinical estimate

Wellman followed a group of 78 to college age and found a mean *IQ* gain of 8.2 points. Her group was from three to eight years at the time of the first test Cunningham studied 37 children, first tested at 12 months and then tested seven years later The group showed a median change of 9 *IQ* points

I should like to refer to an earlier study in which I reported on 436 retested children At the time of the last examination the age range was from 12 months to eight years, with the modal age between three and four years With that group the diagnoses show considerably less fluctuation than is true in the present study. The interval between the tests was considerably less and most of the children were retested with similar preschool material and not with the Binet and Pintner-Patterson *Scales* For the entire group studied, 20 per cent varied by 10 or more *IQ* points, of which two per cent varied by 20 or more *IQ* points This indicates that for the group as a whole, even those at the younger levels of one and two years, the percentages of stability correspond more nearly to the present three-year group reported Apparently the explanation for this change in constancy is due to the different intervals between the first and last tests

Comparing the data of this present investigation with other research studies, the group of 173 three-year-olds gives validity correlations as high as are usually reported for school age children Under three years, the correlations are lower and the amount of *IQ* change greater than we hope to get when we are concerned with individual prognoses, but the retest results are, after 12 months, decidedly more constant than chance expectation.

Finally it seems important to try and analyze why test results of the one- and two-year group are less dependable, and also what are the reasons for extreme fluctuations with certain preschool children. I should like therefore to review some sample case material which suggests some of the factors involved in *IQ* change.

> *Case 1.* D.M. was two years old when received from one of the hospitals for convalescent care. She had an extreme case of eczema, her hands and legs were bandaged and she just sat, unable to do anything. Physically she was very retarded. At 25 and 31 months the *DQ*'s were both 50. She finally walked with help at 35 months, but not alone until 42 months. At 39 months she was just beginning to put a few words together and all of her language was poorly articulated. At 51 months the Binet *IQ* was 66, at 58 months, 72. At 73 months she was last seen and was then with her own family. By that time her skin was almost cleared and physically she was in fairly normal condition, though relatively small for her age. At that time her Binet *IQ* was 83 and the *CQ* 80. Further reports are that she entered school and has been getting along fairly satisfactorily. This case seems to be one where the mental retardation was very positively associated with an extreme physical problem, which further limited the possibilities for normal mental stimulation.
>
> *Case 2.* P.B. was a foundling, received by the social agency from the city hospital at the age of one month. All through his first year he was very slow physically and mentally. He had nasal diptheria and was a feeding problem. At 12 months he weighed just 11 pounds. The first teeth erupted at 14 months. At 23 months he walked alone. The first psychological examination was made at 24 months. Vocabulary consisted of six words. The *DQ* was given as 70. At 36 months a diagnosis of low average was given and the Binet *IQ* was 100. He was still very pale and fatigued easily. At 52 months the Binet *IQ* was 111. Qualitatively he was good, thoughtful about all that he did, but slow in his reactions. On the last test at 10 years 10 months, the Pintner Patterson tests gave 50 percentile results and the Binet *IQ* was 103. School progress had been very satisfactory, and he had a number of years before been adopted by the family who had taken him to board when he was a baby. Of course in this case

we had no data on family history or pre-natal care The early retardation seemed to be essentially due to physical causes

Case 3 H.W. was a miserable looking, badly neglected child when he was deserted by his parents and taken into care by the social agency On the first test at 13 months a *DQ* of 80 was given His motor development was seriously underdeveloped At 19 months his weight was average for 12 months, and a diagnosis of borderline ability was made At 24 months he did not yet walk alone, and his vocabulary consisted of about 50 words, used singly Sentences began at 35 months At 36 months the Binet *IQ* was 72 At 49 months the Binet *IQ* was 78 At the time of the last test at 5 years 8 months, the performance tests averaged 70 percentile, but the Binet *IQ* was 82 This followed out the earlier development of slow language acquirement A number of factors seemed to operate in the case of this child—poor early environment, retarded physical development, and inferior inherited mentality

Case 4 G.W had a long hospital residence due to mastoiditis and pneumonia The first test was given when he was 23 months old at which time the *DQ* was 85 He walked at 21 months, and at 23 months had about 25 words When tested at 37 months the Binet *IQ* was 109, at 49 months the *IQ* was 102 When last tested at 5 years 9 months the performance tests averaged 60 percentile, and the Binet *IQ* was 113 A severe illness, with consequent lack of normal mental stimulation, seemed sufficient to explain the child's early retardation

Case 5 Another interesting child was R.E who was received by the social agency shortly after he was a year old His early care had been very inadequate At 16 months he had just begun to pull up onto his feet, he used just one word and on the basis of all his responses a *DQ* of 75 was given At 27 months he began using sentences and did exceptionally well with concrete material At 40 months the Binet *IQ* was 110 At 68 months the Binet *IQ* was 112 and the performance tests averaged 70 percentile With this child there was no pronounced or specific physical problem, but he was frail, emotionally sensitive, and very slow in adjusting to the foster home which later adopted him

Case 6 R.L had spent all his very early life in an institution and was first tested there when he was 17 months old, at which time a *DQ* of 75 was given He was transferred to a private boarding home and on each subsequent test was living with a foster family At 25 months the *DQ* was given as between 80 and 85, at 31 months, as 90 On the last test at 5 years 9 months the Binet *IQ* was 104 and the performance tests were all average This child was always a husky little boy, he seemed very happy and adaptable, but apparently the institution failed to offer mental stimulation which brought out the potentialities which were later developed in the foster home

Case 7 J S was an own child of college parents On two tests at 11 and 17 months she measured up to the Gesell norms but showed no acceleration. At 29 months she showed advance development with concrete material such as color matching and the Wallin *Pegboards* and also with verbal material She was given a *DQ* of 110 At 8 years 3 months she was a year accelerated in school, rated 40 percentile on the performance tests, but gave a Binet *IQ* of 123 This child seems to illustrate what might be predicted when at an early age it is impossible to get an indication of abstract verbal ability and when other development is just average It is interesting that in the last study, concrete ability was lower average but superiority was in the intellectual field.

Case 8 M E presents a good deal the same picture as the previous child On the first test at 25 months she gave no indication of ability which was at all above average and even failed to show any discrimination between color cubes At 13 years 6 months she was making excellent grades in school and had a Binet *IQ* of 130. With performance material she was only slightly above the 50 percentile point This girl undoubtedly has superior intellectual ability which available tests had not been able to detect at an early age, but with practical material she did not show any acceleration

Case 9 J P was first tested at 8 months and given a *DQ* of 75. Soon after, he was transferred to a more desirable foster home where the foster mother was a nurse and where he received a great deal of affection. At 12 months the *DQ* was 85 At 17 months he was walking around chairs and used four words. At 24 months he played in a very satisfactory way, gave responses to concrete material which were characteristic of that age group. He seemed very normal except in the language field, where he was at least six months retarded, having only a vocabulary of 12 words It was difficult to check on his comprehension of verbal symbols as he was very shy and avoided any contact with strangers which involved talking At 36 months concrete results were average, but the Binet *IQ* was only 88 He still was very inhibited verbally, and retiring with all strangers At 4 years 5 months he was much better adjusted emotionally and his Binet *IQ* was 105 On his seventh and last test at 6 years 11 months he gave a Binet *IQ* of 109 and was making a good adjustment in first grade This is another case where failure to use language at the appropriate time gave results which were considerably changed at a later date Very probably his withdrawn personality was a part of the language retardation

Case 10 Another child, W S, I should like to comment on because he seemed so much more able as a baby than later His mother and older brother had been diagnosed as feebleminded This child was a sturdy and robust baby The foster mother thought he was quite perfect and probably stimulated him to the peak of his accomplishment At 13 months he was slow but given a *DQ* of 80 At 20 months he walked alone At 25 months he had a few words but made no combinations At that time the *DQ* was 75 At 44 months, still no sentences were made, and on the basis of test data he was rated 65 At 56 months a definite diagnosis of moron ability was made—*DQ* 50 Qualitatively he was typical of subnormal children, but continued to be a husky, active boy physically He was last tested at 71 months when the Binet *IQ* was 42 He is now institutionalized and the school authorities have no doubt about his being feebleminded, but say that he is one of their more trainable children, and that he makes very nice objects in the wood shop The factors which seemed to distort this picture was a motor development and general physical activity which was not so seriously retarded and it was only as the period for language was reached that his limitations became increasingly evident Even now in the feebleminded institution, he is relatively good with handwork, but by a verbal estimate, is very definitely retarded

Case 11. I followed R S through a series of nine studies There never was any explanation for slowness, except apparently as a constitutional factor He was sluggish, placid, even going He lived in two different boarding homes and was very much accepted by both At 20 months the *DQ* was 70, at 35 months, 70, at 46 months, the *DQ* was 70 and the Binet *IQ* 65 At 57 months the Binet *IQ* was 69, at 69 months, 81 At 6 years 9 months the Binet *IQ* was 91, at 9 years, 87, and at 10 years 1 month the Binet rating was 84 and concrete ability by the Pintner-Patterson *Scale* was 50 percentile The reason for improvement with age seems to be one of those undetermined things

Case 12 F W was a pretty child, attractive socially, and she always had had a desirable environment, good physical care, and the usual amount of affection and mental stimulation Her mother worked in an office At 21 months the *DQ* was 60 At 27 months F only walked around furniture She said a number of single words but made no sentences At 37 months a *DQ* of 85 was given though the Binet *IQ* was 92 At 49 months the Binet *IQ* was 85, at 77 months, 83 On the sixth and last test at 7 years 9 months the Binet *IQ* was 82 and the performance tests varied from 0 to 40 percentile School work was difficult and without doubt F is a dull child, but the earlier possibility of feeblemindedness has been ruled out. In this case there is no explanation for the improvement in test scores

I have given these twelve case summaries because they seem typical of many others where on retests, considerable fluctuation in ratings was shown As I have previously said, we can predict later mental ability with a large percentage of small children But because in individual cases we get considerable instability, it is desirable to try and analyze the reasons for the changes

Health conditions, if they are marked, can interfere with mental development There are, however, only a few conditions which leave a permanent disability, namely, severe toxic infections and injuries to the central nervous system Somatic conditions may cause temporary retardation, such as Cases 1, 2, 3, and 4 But each of these may also have been complicated by other situations of a general environmental sort In analyzing *IQ* changes of 10 or more points, I did not find physical reasons in more than 10 to 15 per cent of the cases, and as suggested above, other causes may also have entered in What this health factor might mean in the general population is hard to estimate, but probably a greater number of children would suffer from physical problems than was true with this group, which was largely under the care of a social agency The highest type medical service was given, the kind which few families could afford.

A great deal has been written about the *emotional resistance* of small children to formal test programs I feel that this problem as it effects correct diagnoses has been given too much emphasis As was discussed earlier, techniques appropriate to small children will eliminate much of this difficulty. This does not suggest that all little children are entirely amenable to test situations, but that with experience, the problem can be met so that there will not be a serious distortion to the correct psychological picture. The more serious aspect of emotionality as reflected in test results, is not with children who are negative or difficult in a specific test situation, but with those whose life pattern as a whole presents problems. The very shy, inhibited, withdrawn youngster, or the dominating, over aggressive one, is the type referred to, and is illustrated in Cases 5 and 9. Of those cases showing *IQ* changes of 10 or more points, I found less than 10 per cent had emotional problems which interfered with their responses to a degree that diagnostic difficulties were presented.

The problem of effects of environment on mental development is complicated and open to dispute. Freeman says:

> On the whole, attempts to analyze individual abilities into *amounts* due to nature and nurture have left the problem unsolved and it is likely to remain unsolved until every one of the innumerable factors in a given person's environment has been identified and quantitatively determined and until their dynamic inter-relationships are determined, beginning with the environmental influence operating from the moment the ovum is fertilized. Until this state is achieved, the calculation and assignment of quantitative values to nature and to nurture will be valuable principally as a statistical exercise.

All investigators are not as sceptical as Freeman in the possibility of being able to isolate environmental causes. Regardless of the exactness with which the effect of our surroundings can be measured, it is generally agreed that the influence is a considerable one. The term environment has such a wide connotation that it may mean anything from amount of sunlight and fresh air to the subtle, stimulating factors which are produced by personal contacts in play and conversation, or by books, etc.

I should not care to estimate quantitatively the degree to which environmental stimulation may effect a particular individual. But I can pick out a group of children who had lived in under-privileged homes, and when they moved to homes where good physical care was given, where play materials were abundant, where intelligent conversation was encountered, and where satisfactory emotional life was possible, then these same children evidenced an accelerated mental development. For about 25 per cent of those whose *IQ*'s varied on retests by 10 or more points, environmental change seemed to be the primary explanation. Cases 1, 3, 4, 5, and 6 appeared to have been effected definitely by the environment in which they had lived

Regardless of the extensive experimentation with preschool tests and the merits of the available scales, it must be recognized that extrinsic limitations exist so far as a complete evaluation of the small child's potentialities are concerned. This is particularly true with respect to the use of language. Because most children are talking freely by the age of three, it is not frequently difficult to secure an estimate of the functioning of language insofar as it can be inferred from its quantitative manifestations If shyness inhibits their verbal responses, we can usually secure reports from the parent as to the level of verbalization, or we can check on comprehension by having them point to specific objects or pictures, or test their ability to follow commands and directions For the two-year-old, although failure to have begun using sentences is below average, with some children, as shown in Cases 2, 4, 5, 6, and 9, it may not be significant of any later problem. Language slowness may, as in Case 9, have an emotional determinant and not be associated with a permanent intellectual retardation.

The more serious aspect of test limitation is presented with the study of very young children for whom it is possible to make extensive observations of motor development, adaptive behavior, and social responses, but for whom later verbal facility can only be anticipated because of other general development Until language begins to function it is not possible to evaluate the capacity which may be shown for dealing with problems requiring the manipulation of verbal symbols. As in Cases 7 and 8, it is undeveloped language which causes so many superior children to be unrecognized early Lack of information as to how an individual will utilize linguistic symbols may also cause an over-evaluation of the ability of a retarded child, such as Case 10, where in other fields fairly normal ability was displayed. If body control is adequate and concrete material is handled relatively well, it is quite easy to assume that language slowness is not too significant and may not indicate any later problem. This is especially true for children under 30 months

The test limitation in the language field seemed to account for about 20 per cent of the cases who later changed their diagnoses by more than 10 *IQ* points

What of the rest of the cases whose ratings varied on retest by more than 10 *IQ* points—in this study approximately 30 per cent?

It seems that they have frankly to be put down as *cause undetermined* Cases 11 and 12 fall in this category.

In summary, discussing the causes producing *IQ* change beyond the range of the probable error, I think Driscoll has made an excellent statement She says we are "confronted with a complexity of interacting factors which can seldom be completely isolated under experimental conditions and whose separate influence on the variable in question is consequently difficult to evaluate." Undoubtedly we can list as frequent and known causes for fluctuation in test scores—physical condition at time of first test, marked emotional problems, environmental changes, and lack of developed language or other psychological traits which the nature of the tests makes it impossible to study.

F. Conclusions

1 In psychologically evaluating a young child, test items should be carefully selected, appropriate test techniques utilized, and qualitative estimates considered. Other available data, such as physical condition, emotional patterns, developmental history, family background, and environmental factors should also be considered and all carefully weighed in deriving the developmental quotient.

2. A study of 250 children, first tested at one, two, or three years, and retested at from five to 13 years, show that with age increase, greater validity correlations are obtained

3 The validity correlations of a three-year group, secured from preschool tests and later Binet and performance tests, are very similar to correlations reported for older and school age children

4 Mean *IQ* changes also are related to age and decrease from 15 points under one year to 8 points at three years.

5. Preschool children showing a variation on retests of more than 10 *IQ* points, will improve in at least three times as many instances as they will deteriorate.

6 Thirty-six own children, on retests, did not give figures significantly different from foster children of similar age

7 Of 33 superior children, approximately half were similarly diagnosed on an initial test

8. Of 18 feebleminded children, approximately 90 per cent were similarly diagnosed on an initial study.

9. Changes of 10 or more *IQ* points can be attributed to the following causes, although it is impossible to estimate mathematically

the influence of each cause for a particular individual Suggestively they are due to (*a*) poor health conditions, 15 per cent, (*b*) emotional factors, 10 per cent, (*c*) environmental situations, 25 per cent, (*d*) limitations within the tests, particularly with language, 20 per cent, (*e*) undetermined, 30 per cent.

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The Journal of Genetic Psychology, 1941, 58, 289-306

JUMPING-ROPE RHYMES AND THE SOCIAL PSYCHOLOGY OF PLAY*

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A. BACKGROUND

In 1927 Bennett (3) published a brief collection of rhymes used in skipping rope, the only one the present writers have been able to find.[1] Yet Chase (9) lists jumping rope as among the first 10 most popular games in the New York City streets in 1905. Schwendener (33), investigating game preferences of 10,000 fourth-grade children, found jumping rope third in order of frequency, mentioned by 1,182 of them. Lehman and Witty (21, p. 60) reported from one-fourth to one-half of the girls between 8½ and 12½ years of age engaged in jumping rope during the course of a week, with a very high frequency compared with the other play activities listed.

Rope jumping has had a long history and has been carried on in many cultures other than our own. Ropes were jumped in ancient Greece (26), and reputedly can be seen in Egyptian museums (2). Women born in Russia, France, Sweden, Austria, and Czecho-Slovakia have told the writers of jumping rope as children while singing accompanying lyrics in their native language.

B. PURPOSE

The present study was carried out, then, for two reasons—first, because of an interest in the social psychology of jumping-rope rhymes *per se*; second, because of the bearing which observations of this special type of play activity might have on theories of play in general.

1. Jumping rope as a play activity for children involves group participation in which not only the physical activity of jumping, running, and skipping is involved, but in which there are characteristic language patterns based on vocalizing coupled with gestures. The

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*Received in the Editorial Office on December 13, 1939.

[1] Just at the completion of the present manuscript, it was learned that a collection of *Folk Jingles of American Children* will be published by Mrs. Dorothy G. Mills Howard (*Time* magazine, August 21, 1939, 34, 54-55).

language behavior observed in jumping rope is a forceful medium of communication and culture transmission.

Language helps the child to understand his surroundings, reflects his social environment, permits recall of past experiences, and transmits to other children in the group and in subsequent age groups some of the fundamental concepts and attitudes of the present group. "No other index is so accurate of the child's social environment as his use of language" (6, p. 113). Language used by children in jumping rope is one special instance of this point.

For very young children, play is highly individualistic, small groups of two or three individuals beginning to form ordinarily only when children are about four years old (17). The group enlarges with age of its participants, double competition groups appear, and with further cleavage teems with organization and rules. Jumping rope is, however, the function of a group of indefinite number, double competition has not appeared, and what very few regulations exist are made by the children themselves subject to change if they think the group will profit.

As offsprings of the typical play group, gangs and congeniality groups arise; these are "transitions" between primary and secondary groups (38). A group of children jumping rope, however, is a typical primary group, the play group. Behavior is spontaneous and natural, and personal social influence is direct. Jumping rope ordinarily occurs without adult control, rule, or dictate. It is usually not taught in schools, and apparently few adults are ever conscious of what their children are saying in jumping or how they jump.

2. A study of jumping rope rhymes also has a direct bearing on the various theories of play. Most of these theories, not formulated on the basis of empirical observations or experiments but based on rationalistic thinking, simply represent an attempt to fit some special ideas into the scheme of play. Thus, Schiller (32) and Spencer (34) thought play the result of expenditure of excess energy, superfluous actions performed in the absence of real activity for immediate gratification through release of tension. Lazarus (20) indicated that play is recuperative to the mentally and physically fatigued, while Patrick (28, p. 29 ff.) has more recently suggested that play is a relaxation from the use of a set of muscles and follows along "deeply rooted race habits." Groos (15) has written of play as an instinct leading to interaction with others—a preparation for adult activities through

practice in social adjustment. G. Stanley Hall (16) believed that play is "instinctive with heredity" and *recapitulates* the cultural epochs of the race. McDougall (23) differentiated between original urges and modified forms of them or play "instincts" expressed in less serious actions. Appleton (1) concluded that play is founded as a maturation process in an instinctive physiological urge for growth. These and other theories of play are discussed in greater detail in another paper (8).

The popular view of most parents is probably wrong, that child play is a mere pastime. Play for children is serious and all-absorbing (41, p. 301). Where play is concerned, there is almost no part-participation or idleness on the child's part. When such an activity is a large factor in the genetic process, its influence must be very great.

The "moral" and "mental" advantages of social participation in forming character and personality have been stressed by many. Curti (11, p. 338 ff.) suggests that play aids in the total adjustment of the individual by helping him to obtain a varied and imaginative approach to problems. Whitley (38) mentions moral values taught through group compulsion to fair play. Nevertheless, Witty (39) found upon testing school children and upon having teachers rate the same children on character and personality traits that children of medium and low sociability appeared as well adjusted to life, tended to rank higher scholastically, and with the exception of "personal attractiveness" ranked higher than the more sociable children on personality and character traits.

C. Bases for Collection of Rhymes

This study, then, centers around the language behavior of children in jumping rope, as indicative of their fundamental habit-patterns and attitudes which may be mirrored in this play situation (cf., 10, also 19), and as possible indices of the basis of play activities.

The data were collected by the junior author (referred to hereafter as the observer) by visiting the Grant Elementary School in Washington, D. C., during noon recess periods, and by playing in the afternoon over a period of several weeks with children in her own neighborhood from the Somerset, Maryland, Elementary School. Sully pointed out that, "A child is quick in spying whether he is being observed, and as soon as he suspects you are specially interested in his talk he is apt to try to produce an effect" (35, pp 21-22) This difficulty was largely overcome, however, by the observer turning the rope herself, a task usually disliked by the children because they prefer the active jumping, and also by jumping herself as the occasion demanded. Also there was not such a great age difference between the observer (age 21) and that of the children that she could not enjoy her former favorite play

Although children as young as 5 or 6 are seen to attempt jumping, the peak of popularity for the game is reached at a period from 8½ to 13 years of age, following which there is a steady decline (21), hence, our observations were principally of this age group (although a few children observed were 6 and 7) Jumping rope is a seasonal game in that it occurs most frequently during the spring months, especially April (21, p 198), hence our observations were made during April, 1939. Finally, although boys as well as girls jump rope, the game is predominantly popular with girls (21), hence, our observations were only of girls

The greater popularity of the game with girls is partially explainable in terms of several factors Lehman and Witty (21, p 104) found the greatest difference in play activity between boys and girls during the years from 8½ to 10½ They found boys' games during those years characterized by vigorous action, competition, and some organization Jumping rope involves a restricted range of action, little competition, and very little organization Girls' activities tend to involve the use of language to a slightly greater extent than boys' games Then, too, practically all investigations have shown a small but persistent superiority in general linguistic ability of girls over boys (14, 36).

D. Representative Samples of Rhymes

Samples of rhymes collected which are representative of jumping-rope behavior among these girls are presented in this section, together with psychological evaluations

Jumping rope is one of the folkways of our culture, somewhat similar to the counting-out rhymes, the nursery rhymes, and the many traditional games of children (cf, 5 and 25) The first two lines in the following are remnants of the ancient counting-out rhymes, still persisting in jumping rope today

Ibbity, bibbity, sibbity, sab,
Ibbity, bibbity, ranahoo,
Dictionary down the ferry,
Out goes you.

The universality and general uniformity of action produced by the two first lines (cf., 7, p. 4) is surprising when one considers the great regional differences. Yet these lines, and others, have continued for generations in the folkways of children, as the result of such factors as conditioning, common stimuli in learning through social interaction, etc. Several of our 1939 rhymes were also recorded by Bennett (3) in 1927.

We have heard children insert phrases of their own composition when the correct ones were forgotten or when they realized that the jingle was not directly applicable to their situation. The turn of the rope regulates the rhythm, and several members of the group offer suggestions. Probably the changes are somewhat gradual, for several endings are often found for the same rhyme, for example, for "*ranahoo*," the last word in the second line above, children in other communities chant "*canabo*," and still others, "*canalboat*"!

This means that jumping-rope rhymes change in their thought and content with the times, maintaining the same general rhythm, repetitions, and occasionally some of the verses. For example, the following rhyme was not sung 12 years ago when the observer jumped rope, but obviously dates from the dancing fad of 1937-38 known as the *Big Apple*:

Swing your right foot,
Turn around,
Suzy Q,
And truck on down.

This is a far cry from the kind of verses chanted by earlier generations of children, which likewise reflected some of the adult folkways of the period. For example (3):

"Mother, Mother, what is that
Hanging down the lady's back?"
"Oh, you little sassy thing,
That's the lady's corset string."

Here are two more 1939 samples of the utmost modernity, representative of an appreciation of current adult attitudes:

A tisket, a tasket,
Hitler's in his casket,
Eenie, meenie, Mussolini,
Six feet underground
[Some children replace the last part
with "cut him down."]

Red, white, and blue,
Your father is a Jew,
Your mother is a Japanese,
And so are You!

"Japanese" has been substituted in the third line for *"Chinaman"* (formerly used), an obvious concession to the times. As Lois B Murphy has recently pointed out, "The play patterns of the children are a mirror of the culture which surrounds them, and this culture provides the raw material for their activity and fantasy" (27, p 60)

The influence of the movies is reflected in the couplet apparently dating from the recent cinema, *The Little Rebel*

Shirley Temple takes a bow,
John Boles shows her how

Adoration of the child movie star, indicative perhaps of identification, is further shown in the following

Shirley Temple, turn around,
Shirley Temple, touch the ground,
Shirley Temple, go up stairs,
Shirley Temple, say your prayers,
Shirley Temple, go to sleep;
Shirley Temple, don't you peek

There is no doubt that jumping-rope rhymes unconsciously mirror the child's environment Here is an example from the "comic" sheet·

Toots and Caspar went to town,
Tootsie bought an evening gown,
Caspar bought a pair of shoes,
Buttercup bought the *Daily News* [a Washington newspaper].

Before the repeal of prohibition, children jumped to

Ice cream, soda-water, ginger-ale, pop.
Tell me the initials of your sweetheart
A—B—C—D—etc. [until the jumper missed]

Now the children in the same neighborhood naively chant

Mary ate some marmalade,
Mary drank some beer,
Mary ate some other things
That made her feel so queer

Oops came the marmalade,
Ooo-oops came the beer,
Ooo-ps came the other things
That made her feel so queer

When the observer, as a little girl, jumped rope, the children chanted a tune of family disagreement to which they had added at the end the refrain from a then current musical comedy·

"Mama, mama, may I go
Down to the corner to meet my beau?"
"No, my darling, you can't go
Down to the corner to meet your beau"

"Papa, papa, may I go
Down to the corner to meet my beau?"
"Yes, my darling, you may go
Down to the corner to meet your beau"

I should worry, I should care,
I should marry a millionaire
If he should die, I should cry,
I should marry another guy

We must be cautious in interpreting all rhymes as representative of adult attitudes accepted by the children. A child of 7 uttering the following rhyme is probably not compensating for her parents' refusal to let her help with the housework, but is learning the terms of a duty which her older jumping companion has to perform every evening·

Mabel, Mabel,
Set the table
Don't forget the—
Salt—vinegar—mustard—pepper—
[faster and faster]

Interesting in connection with this jingle is Drever's (12) conclusion that expansion of a child's environment always tends to increase use of nouns relative to that of other parts of speech The above rhyme has more nouns than all other parts of speech put together, and many of the others recorded include a large proportion of nouns

Bolton points out that "childish imitation is apt to be uncritical" (6, p 111). The rhyme below has final vowel and consonant alliteration and a certain "catchiness" It is certainly accepted uncritically Perhaps the alliteration appeals to the child's aesthetic pleasure in words (22):

Did you ēv-a, īv-a, ōv-a
In your lēf-a, līf-a, lō
See a dēv-a, div-a, dōv-a
Kiss his wēf-a, wīf-a, wō?

No, I nēv-a, niv-a, nōv-a
In my lēf-a, lif-a, lō
Saw a dēv-a, dīv-a, dōv-a
Kiss his wēf-a, wīf-a, wō

Lowenfeld (22, p. 107 and p 152) believes that imitation in play is the result of the child's necessity to externalize his sensory experiences and phantasies in order to assimilate their reality, that before 8 or 9 years of age a child does not use words to communicate ideas but always to express the sensory experiences he externalizes in play. Realization of his environment would thus come through dramatization of himself, material objects, his emotions, and his family (22) Ellis and Hall (13) observed this element of dramatization in the pretenses of children that their dolls were sick or hungry. This idea is illustrated in the two following jumping-rope rhymes

Grandmother, Grandmother, I feel sick
Send for the doctor, quick, quick, quick.
Doctor, Doctor, shall I die?
Yes, my darling, by and by
How many pills shall I take?
One—two—three—four—etc

Dolly Dimple ate a piece of cake,
Dolly Dimple got a tummy ache
Dolly Dimple went to bed,

Dolly Dimple fell down dead
  [Hereupon the jumper falls prostrate
    on the ground.]

There are definite social traits expressed in speech which have developed through group participation at a characteristic social level, in certain geographical regions, or with certain "classes." These differences over and above individual differences definitely color speech and are manifested in vocabulary, gesture, intonation, pronunciation, style, and rhythm of speaking (31). The following presumably originated in England

John said to John, "How much are your geese?"
John said to John, "Fifty shillings apiece."
John said to John, "That's too dear."
John said to John, "Get out of here."

[Other groups insert "cents" for "shillings."]

The (possibly) young composers of the rhyme below might have served as substitute mothers of smaller children at play in the streets of some over-crowded tenement section

Old man Daisy,
What do you think I did?
I upset the crib
And almost killed the kid
The kid began to holler,
I grabbed it by the collar
The collar came loose,
And I got the deuce

The location in the following is definite. In three lines it paints an adequate picture in words of some children's surroundings. In addition, this rhyme yields an excellent opportunity for accent coloring

Your mother, my mother, live across the way,
Two hundred thirty-three East Broadway
Every night they have a fight,
And this is what they say
"Aca baca, soda cracker,
Aca baca, boo,
Aca baca, soda cracker,
Out goes you."

In the above we again see an old counting-out rhyme included Counting-out is likewise involved in the following selection, and the rhyme is also like the one above in that it conveys a childish impression of neighborhood quarrels

Your mother and my mother
Were hanging out clothes.
Your mother gave my mother
A punch on the nose
Did it hurt—yes or no?
Y-E-S spells "Yes,"
And out you go

Racial prejudices are already formed to some extent in these girls of jumping-rope age, but these overt verbal expressions for the most part appear to have been built up by adoption of ready-made attitudes Thus, the word *"nigger"* in the two following rhymes seems to have no vividly disagreeable connection with the children's feelings It is apparently just a word denoting an individual and does not seem to have much assimilated reality for the jumpers

I don't want your apple,
I don't want your pear,
I don't want your fifty cents
To kiss behind the stair

I'd rather wash the dishes,
I'd rather scrub the floor,
I'd rather kiss the nigger boy
Behind the kitchen door

Another in more childish vein has little rhyme or apparent meaning.

There was a little nigger—
Put him in a trigger,
Sent him to the ten cent store
Fell out the window,
Broke his little finger,
And then he went home

A different story, however, is told by the following fragment This verse was suggested at the end of a longer ditty by two girls who were immediately hushed by the group with the admonition, *"That's not nice"* The observer was unable to hear the rest of the rhyme. The fragment heard indicates an attitude probably built up in the past through a process of integration, now expressed verbally with emotional tone. No doubt it will strongly influence other forms of behavior.

And if your father spits tobacco,
Then he's a dirty Jew.

The sex *motif* is strong in jumping-rope behavior. Not only are the words "beau" and "kiss" of frequent occurrence in jumping-rope vocabulary, but rhymes involving love-making and having "dates" are among the most popular. Here are five examples:

Two years old,
Goin' on three—
I wear my dress
Above the knee.
I walk in the rain,
I walk in the snow,
And it's nobody's business
If I do have a beau.

My sister's got a boy-friend
Who comes every night.
They go into the parlor
And turn out the light.
I peek through the key-hole,
And this is what I hear:
Johnny, Johnny,
Take your arms away!

Nine o'clock is striking,
Mother, may I go out?
All the boys are waiting
For me to take me out.

Cinderella, dressed in yellow,
Went down town to buy an umbrella.
On the way she met her beau
Who took her to a five-cent show.
When the lights were turned down low,
How many kisses did he give her?
One—two—three—four—etc.

Down in the meadow
Where the green grass grows,
There sat Mary Jane,
As sweet as a rose
Along came her boy-friend
And kissed her on the nose
How many kisses did she get?
One—two—three—four—etc.

Upon entering the group, a younger child often does not grasp the meaning of some of the rhymes. One girl of about 6 insisted to the observer that *"as sweet as a toes"* was the correct version of *"as sweet as a rose"* (above), although she admitted that the others said *"rose."* However, through the gestures accompanying the rhymes, the suggestions of the older girls, imitation of them, and motivation by group approval when the rhyme is recited correctly, the younger child quickly adapts herself.

Gestures illustrating the words are characteristic of all the above rhymes—turning, stooping, throwing kisses, and so on. If the action is vigorous, the jumper remains silent while the group chants on, watching the jumper attentively. The indicated motion is acted out in the following short rhymes:

Down the Mississippi
Where the boats go *push*
[illustrating]
Lady in a boat
With a white petticoat,
And her name is *Miss*

"House for rent—
Inquire within."
When I *move out*,
Let Jane *move in*
[etc., etc.]

Individual differences are slight and of little importance. Conformity is the order of the day. The rope-jumping of children is about as fundamental a level as can be found in any situation of social stimulation and response (cf., 24).

Teddy Bear, Teddy Bear,
Hops on four feet, four feet,
Teddy Bear, Teddy Bear,
Jumps on out—*Skidoo!*

E. GENERAL INTERPRETATION

Two questions were raised at the outset, one concerning jumping-rope rhymes *per se,* the other concerning the relation of these rhymes to theories of play.

1. First, as to the rhymes themselves, imitation and particularly social imitation by girls of this age group seems very obvious. In fact, the jumping-rope situation seems to involve imitation of former rope-jumpers, imitation of others in the group, and imitation of adult patterns of behavior. Robinson (30) attributed "imitative" play in children, together with the frequently accompanying phantasies, to a compensation for the incongruity between impulses and the surrounding world. Curti (11, p. 359) adds that this substitutive play can never be more than a temporary or partial means of adjustment. Bolton writes: "A newer view, however, regards imitation as one of the most important modes of learning on the part of intelligent adults as well as of immature children" (6, p. 111).

Yet is imitation the whole story? After all, to say that children in chanting the same jumping-rope rhymes are simply responding to "imitation" is to substitute a rather loose concept for an explanation. The great uniformity of action in the language and gestural behavior connected with jumping-rope rhymes can certainly be explained only in terms of a large number of related factors (cf., 29). Some of these are: practically identical innate structures, common stimuli, common language and other symbols of thought and action, the stimulation of enthusiasts in the group, the entire conditioning process, the probable embarrassment, together with the probable disapproval of one's fellows, from acting too differently, the probable approval and friendship of others as a reward for "correct" behavior, the probable elevation of an individual by an unusually good adoption of the special activities and manners of the group.

Thomas's four wishes (37, pp. 4-32) are also most certainly satisfied in the jumping-rope situation. New experience is furnished vicariously in new and more complex rhymes and in learning the variety of twists and turns in jumping. Response is apparent in the sociability and acquaintance of friends who join the group Recognition is offered in performing the rhyme without "missing" and, if proficient enough in jumping, in being able to lead off and choose the order of those who follow behind. Security is preserved by the rhythmic turn of the rope and the ability to rely on old well-learned rhymes that can be done with ease

As for the learning factors involved, rapidity of learning is enhanced by pleasant sociability, interest in the game, the repetition, the rhythmic action, and perhaps, even, by spaced learning (40, p. 268) (since each child must wait her turn).

2 Second, as to theories of play, parallels have repeatedly been drawn between the language and play of small children and that of primitive savages, helping to give rise to the "recapitulation" theory, that child development explicitly follows the development of the race and can thus explain the latter Appleton (1) found a close analogy between the play of savages and that of children from 7 to 13 or 14 years of age With both, play is in general unorganized, rhythmical, to some extent mimical, repetitive, and carried out principally in social groups Jumping rope, as a play activity popular with girls from 7 to 13, is characterized by every one of these elements

So far as language behavior is concerned, in many primitive groups pitch and tone accents in words are apparent. There is sentence melody, and speech is more "agitated" than ours—like song Words are poetic and graphic in that they appeal to the senses (18)

> In many instances savages are mentioned as very expert in adapting the subjects of their songs to current events Nor is this sort of singing on any and every occasion confined to savages, it is found wherever the indoor life of civilization has not killed all open air hilarity . (18, p 435)

As we have seen, children behave similarly, and when free from adult control chant jumping-rope rhymes, "adapting the subjects of their songs to current events"

From our observations we believe it possible that these similarities in play activities and in language behavior of children and primitives are *not* explainable in terms of recapitulation Rather, this similarity probably results from the fact that both primitives and children are principally members of primary social groups in which contacts are personal and direct. Exuberance and sensory feelings are unrestricted by complex laws or by the remote formalities of a secondary group. Learning is informally acquired through social interaction, imitation, dramatization, and suggestion, but not through organized institutions. The parallel is simply in the "how" of development, and not in the "what." It is in the manner of development, not in the actual details.

We believe that play activities can be regarded as activity complexes, based upon reflexes and random tendencies but organized and molded beneath the pressure of the social environment (cf., 4, p. 348). Some writers have tended to ignore the fact that play is a function in the development of personality and in the socialization of group behavior. Yet it is these various socializing factors acting upon already established habit-patterns which we observed over and over again in the play of jumping rope.

The present paper is not intended to be an exhaustive study of jumping-rope rhymes. It does, however, indicate the value and significance of such a survey. Likewise, it exemplifies the idea that in social psychology there is a firm necessity for objective and scientific analysis of prosaic social situations in the behavior of human organisms.

F. SUMMARY

Samples of rhymes were collected, used by girls from about 6 or 7 to 13 years of age in April, 1939, in the suburbs of Washington, D. C., while engaged in the group play activity of jumping rope. The language behavior of the children was studied in relation to their habits of thought, and also in relation to theories of play. Representative rhymes are interpreted individually above. The following general conclusions are also made.

Jumping-rope rhymes are explainable, not simply in terms of "imitation" but also by a large number of related factors, such as, practically identical innate structures, common stimuli, common language and other symbols of thought and action, stimulation of enthusiasts, conditioning, disapproval for different actions, approval for similar actions, elevation by ready adoption of special activities. The desires for new experience, for response, for recognition, and for security are also mirrored in the rhymes. Learning factors are also involved.

The rhymes are not believed to support the "recapitulation" theory of play. Instead, play activities of the sort studied can be better explained as adjustment complexes based upon reflexes and random tendencies but organized and molded beneath the pressure of the social environment, the play of jumping-rope rhymes is regarded as a socializing force.

The present paper suggests a field for study which involves an apparently prosaic situation, yet which offers empirical data of a valuable sort both for the psychology of children and for the psychology of play.

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The Journal of Genetic Psychology, 1941, 58, 307-326

A METHOD FOR RECORDING THE ACTIVITY OF THE HUMAN FETUS *IN UTERO*, WITH SPECIMEN RESULTS*

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A. Introduction

The student of ontogenetic development has long been interested in the behavior of the human fetus as it grows within the uterus. Yet the natural protection furnished by the uterine and body walls of the mother has served as a barrier against direct and first-hand observation. As a result, most of the available knowledge about the beginning of human behavior has been accumulated from the study of prematurely born specimens. The practicing obstetrician does, of course, make clinical observations upon the cases which he treats. But the full and complete history of the genesis of normal fetal activity *in utero* is still an active scientific issue.

A number of methods for observing the responses of the fetus through the maternal body wall have been in use. Most common among these are the methods of palpation and the indirect procedure of obtaining introspective statements or descriptions from the pregnant mother concerning the nature of the fetal activity which she experiences. The use of technical aids and of special apparatus is by no means new in this connection, since instruments of one sort or another have been employed to assist in making observations upon the fetal organism for more than a century (1, p. 95). The stethoscope, cardiograph, string galvanometer, and X-ray have all been adapted to this purpose.

In recent years the attempt to obtain long-term scientific records of fetal activity has led to the development of pneumatic or tambour-like devices which are fastened over the maternal abdomen. Thus

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*Accepted for publication by Leonard Carmichael of the Editorial Board, and received in the Editorial Office on December 16, 1939.

[1] The writer is indebted to Dr. T. W. Torrey, embryologist, of Indiana University, for reading the manuscript and for helpful criticisms and suggestions.

Ray (3) has devised a 3-tambour system which is taped to the external abdominal wall Sontag and Wallace (7), following the precedent set by Ray, have refined and expanded the pneumatic method so as to obtain more complete records with it. Their apparatus has been successfully used in recording the gross responses of the fetus to external stimuli as well as in other ways (8, 9) Subsequent investigations by Sontag and Wallace (10) and by Sontag and Richards (6) have dealt especially with changes in fetal heart rate[2]

The method described in the present paper is based upon a new and somewhat different principle. Although far from perfect, it nevertheless possesses advantages which recommend it for the study of intra-uterine activity. Since the recording technique is mechanical, rather than electrical or pneumatic, it is, for example, simpler than many of the other methods The essential parts are extremely light in weight and can therefore be easily transported All records are automatic and can be studied and measured at leisure The tracings of the fetal reactions need not be complicated in any way by the respiration of the mother. The method also permits the separate recording of the activity of the caudal and rostral ends of the fetus It should be clearly emphasized, however, that the equipment does require accurate and delicate adjustment, and demands that the mother remain quiet while observations are being made Specimen results from one subject are analyzed and discussed in the following pages

B. TECHNIQUE OF OBTAINING OBSERVATIONS

1. *Recording Mechanism*

Both side and end views of the parts of the mechanism which are fitted over the external abdomen are diagrammed in Figure 1 The abdominal plate or plates, *C-D*, are of 28-gauge sheet-metal, 2½ inches wide and from 8 to 16 inches long, depending on the size of the maternal abdomen. They can easily be bent at each experimental session to match the contour of any particular location When two

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[2] Recent experimental studies of fetal activity which have stressed the introspections of the mother, have been reported by Richards, Newberry, and Fallgatter (4) and by Richards and Newberry (5). A general review of the literature on fetal behavior prior to 1933 has been published by Carmichael (1, pp 95-99)

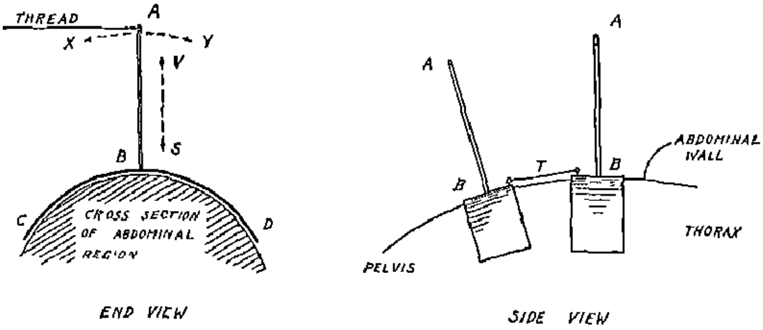


FIGURE 1

SHOWING ABDOMINAL MECHANISM FOR RECORDING FETAL ACTIVITY

A curved plate of light sheet-metal is bent to fit the abdominal wall, in the manner indicated by CD in the cross-sectional view. Any change in the external contour of the abdomen by pressure from within now causes *the plate to tilt either to the right or to the left*. These right-left displacements are transmitted to the upper end of the vertical rod AB as movements of the point A in the direction of either X or Y. A thread attached to AB at A *conveys the motion of the vertical rod to a light muscle* lever which writes upon a kymograph drum. The rise and fall of the whole abdomen in the direction VS, caused by the breathing of the mother, does not as a rule change the abdominal contour. Since A is not displaced in a lateral direction, the breathing movements are not recorded by this technique.

The side view shows the method of adjusting two abdominal plates so that the lumbar plate (to the right in the figure) records the activity of the caudal end of the fetus, and the pelvic plate (to the left in the figure) records the activity of the rostral end of the fetus. The thread T which connects the two plates at their center, prevents the pelvic plate from slipping downward as a result of the steep angle of the abdominal wall at this point.

plates are used, as illustrated in the side view of Figure 1, the one nearest the pelvis of the mother is the shorter of the two (from C to D), while the one over the lumbar region is the longer. Such an arrangement is necessitated by the shape of the abdominal area during pregnancy. If the fetus is in an advanced stage of development, the angle at which the pelvic plate rests on the abdomen may be considerable. In this case, the two plates should be fastened together with a thread, T, which prevents the slipping or movement of the pelvic plate upon the surface of the skin. The light vertical rods AB and $A'B'$ are 6½ inches long and are soldered to the center of the abdominal plates. The combined weight of both plates, together with their vertical rods can be held down to less than four ounces.

In preparation for the adjustment of the abdominal plates the mother is asked to go to bed where she lies upon her back in as comfortable a position as possible. She may even sleep during the examination period. The fetal heart is located with the aid of a stethoscope, and as a check the position of the head, shoulders, and buttocks of the fetus can be determined by palpation. The lower or pelvic plate is then placed over the head and shoulders, while the upper or lumbar plate is fitted over the sacral and leg region of the fetus. The movements of the fetus which are transmitted to the external wall of the mother's abdomen will now cause one or the other (or both) of the abdominal plates to tilt either to the left or to the right. The tilting of the abdominal plate produces a corresponding lateral movement of the upper end of the vertical rod *AB* which is attached to it, in the direction of the arrows at *X* or *Y* (Figure 1). This lateral movement is transmitted through five or six feet of thread, run through appropriately placed agate pulleys, to light muscle levers writing upon a kymographic drum. In addition to tracings from the pelvic and lumbar abdominal plates, a complete record would include a time line, a pneumographic tracing of the mother's breathing, and a line from a recording marker connected to a signal key, by means of which the mother can register the presence and duration of introspectively observed or "felt" movements. When the effects of external stimuli, such as loud sounds or mechanical pressures, are to be observed, a stimulus line may also be added.

2. *The Elimination of Breathing*

Since slight movements of the vertical rods in the direction *VS* (see end view, Figure 1) produce no change in thread tension, they cause no deflection in the fetal activity-line upon the kymographic record. In taking actual records, therefore, every effort should be made by the experimenter to adjust the abdominal plates so that the vertical rods are exactly in the plane of movement of the abdomen caused by the mother's breathing. Except in rare instances, a proper adjustment will entirely eliminate her respiration from the abdominal records.

But such a principle, it should be noted, may also eliminate from the records, small fetal movements which cause the abdomen to rise and fall as it does in breathing. One may rightfully ask to what extent this limits the effectiveness of the method.

There may, of course, be some fetal movements not recorded because of this particular technique, but these must certainly be rare. It is probable, we think, that no fetal response of sufficient magnitude to move the abdominal wall .02 in. or more would fail to produce a slight deflection on the record line. This is because fetal movements change the contour of the abdominal wall, while the respiration of the mother causes the whole abdomen to rise and fall, without changing its contour by any appreciable extent. A fetal push, directly below the lower end of the lever *AB* would cause the whole plate to tilt in one direction or the other, since it would raise the plate so that either the end *F* or the end *D* was away from the abdominal wall. It is unlikely, therefore, that any but the smallest of fetal movements are missed by the recording system described.

3. *Other Sources of Error*

But the possibility of introducing errors, by recording movements not caused by the fetus itself, extends beyond the breathing activity of the mother. Both the uterus and the amniotic sac make smooth-muscle contractions of their own. If these irrelevant responses are reproduced along with fetal activity, will they not be confused with it?

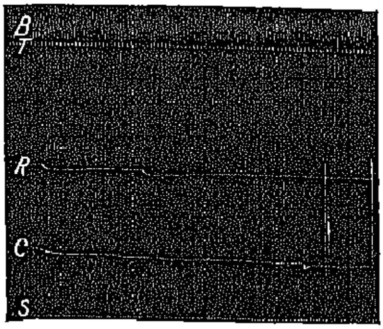
With regard first to uterine contractions, the answer is clear. Uterine contractions are extremely slow, in some instances they last for periods of several minutes. They are similar to the contractions which ultimately result in birth. The change in the record line produced by a uterine contraction is progressive as well as unidirectional, up to the point where the peak is reached. After passing the peak of the contraction, the record line again returns gradually to its previous level. If the arc of the recording lever is discounted, the record of a uterine contraction will appear approximately symmetrical. The contour of the record lines of a uterine contraction produced by the present method, hence differ so much from those produced by the responses of the fetus that an experienced record-reader can readily distinguish the two (cf. Figure 8). Weak or less-obvious uterine contractions can be automatically eliminated from the final results, by a special technique of measuring the records to be described.

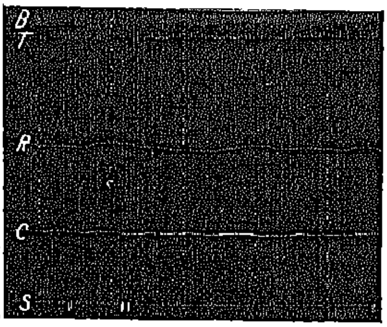
With regard now to the movements of the smooth-muscle tissue of the amniotic sac, there is somewhat less certainty During the later stages of pregnancy, the amniotic sac increases in size until it presses against the chorion on the inner uterine wall Amniotic movements of sufficient strength and magnitude may possibly change the shape of the uterus itself, and by this means cause an alteration in the contour of the external abdomen Whether the independent contraction of the amniotic muscle tissue is able to produce these effects is at present unknown If it is, then the effects would be recorded along with fetal movements by any device which operates on the principle of registering changes in the shape of the abdominal wall Yet even if the movements of the amniotic sac are transmitted to the external abdomen, the resulting changes must be of small extent as well as slow or gradual in occurrence There seems to be no good reason, therefore, why a technique of computing arbitrary fetal movements of specified size occurring within a given time limit (like that to be described) should not automatically eliminate any amniotic disturbance, just as it would the smaller uterine contractions. The figures which are ultimately derived from the kymographic tracings need be made up, therefore, only from fetal movements

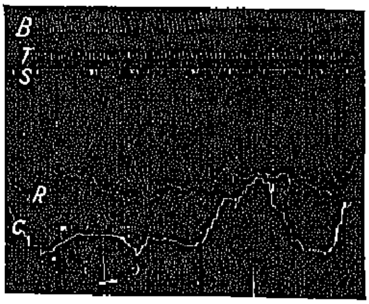
The present method is nevertheless strictly limited It makes no pretense whatever of showing the extent or magnitude of any particular fetal response It offers only a way of getting at the duration of activity, together with a kind of general summation of gross behavior In this respect it is like the actograms of Szymanski, Richter, and Shirley A large fetal movement under C or D would obviously produce a lesser deflection of the point A in the direction X or Y than a small fetal movement which occurred near the base of the vertical rod AB

C GENETIC RECORDS FROM ONE SUBJECT

Specimen records have been taken from one subject by this procedure, from the 170th to the 256th day of fetal life, inclusive The observations were begun slightly after the time when fetal movement was first experienced by the mother They continued until 14 days before the end of the full-term gestation period, which was computed as 270 days from the time of ovulation The fetus was a normal female whose weight at birth was 8 lbs , 3 oz







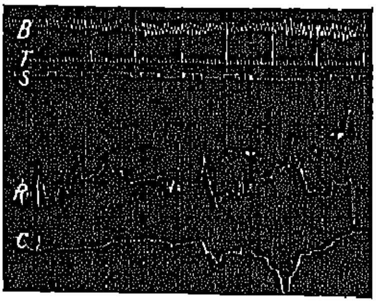


Figure 2 Figure 3
Figure 4 Figure 5

All of these figures are photographs from kymographic tracings The line marked *B* in each of the reproductions is the respiration of the mother *T* is a time-line in units of 5 sec. each *R* is the activity record from the lumbar abdominal plate which covers the head or rostral end of the fetus, while *C* is the activity record from the pelvic plate which covers the leg- or caudal-region of the fetus The line *S* gives the introspective report of the mother concerning the fetal movements which were felt or experienced by her.

Figure 2 shows a portion of a control record taken 40 days after the birth of the fetus Of seven postnatal control records spaced over a period of from 37 to 52 days after birth, the section pictured shows by far the greatest amount of movement in the abdominal lines In most cases, the lines were perfectly straight, indicating no changes in abdominal contour at all Figure 3 is a reproduction of a fetal record made on the 217th day of fetal life It is reproduced here because of its similarity to Figure 2 The small degree of change in the activity lines shows that the fetus was very quiet during this period, and may have been asleep

Figures 4 and 5, by contrast, show periods of considerable activity In Figure 4 (fetal age 197 days) the behavior seems rhythmic, with corresponding movements of the upper and lower portions of the fetus In Figure 5 (fetal age 199 days) there is also a good deal of activity, but the recording lines from the two parts of the body are quite different

Experimental sessions were held at intervals of 24 hours—with some omissions. Each session of recorded observations covered *ca* 18 consecutive minutes. In some cases, two series of observations were taken in close succession, during the same experimental period All readings were made at a constant time of day, between 1.30 and 3 P M The mother rested quietly for 15 minutes before each session so as to eliminate the possibility that any of the fetal movements were responses to her own activity. A total of 1730 objectively recorded minutes of fetal behavior were accumulated in this way.

Additional control records were taken, beginning 37 days after childbirth. These served as a check upon the possibility that respiratory or visceral movements, not caused by the fetus itself, might have complicated the earlier tracings

1 *Some Qualitative Findings*

The appearance of the records obtained, together with some of the qualitative results are illustrated in Figures 2 to 7, which are reproductions from original kymographic tracings The top line (*B*) in all these figures is the respiration of the mother The second line from the top (*T*) is the time line, in units of five-seconds each *R* is the activity record from the head or rostral end of the fetus, while C is the activity record for the leg or caudal end of the fetus The line *S*, which is third from the top in some of the figures and at the bottom in others, gives the introspective report of the mother concerning the fetal movements which were felt or experienced by her.

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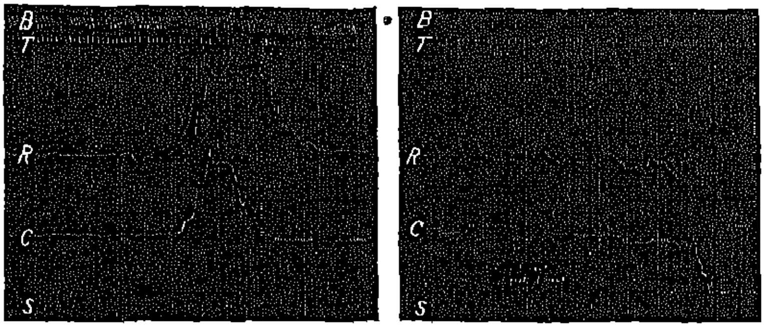
Figures 4 and 5, on the other hand, show periods of considerable movement, the intensity of which varies at different points in the records. In Figure 4 the behavior seems to be rhythmic, with corresponding activity in the upper and lower portions of the organism. The fetal age at this time was 197 days. In Figure 5 (fetal age 199 days) there is also a good deal of movement, but the activity lines from the two parts of the body are quite different. The depression of the mother's key during "felt" movements shows the correspondence which exists between the objective and subjective observations.

Figure 6 shows a reflex contraction of the uterus, or a cramp—not a fetal movement at all. Reflex responses of this sort are a common aspect of the advanced stages of pregnancy. The fetal age at the time of this record was 217 days.



FIGURES 6-7

Lines marked *B*, *T*, *R*, *C*, and *S* in these kymographic reproductions have the same significance as those in Figures 2, 3, 4, and 5. Figure 6 shows a uterine contraction or cramp—not a fetal movement at all—similar to the contractions which ultimately result in birth. Reflex responses of this sort, sometimes lasting for several minutes, are common in the advanced stages of pregnancy. The fetal age at the time of this record was 217 days.

Figure 7 shows the response to a shot from a 32-calibre revolver fired two feet distance from the abdominal wall, when the fetus was 234 days old. The sharp deflection of the markers is not part of the reaction of the fetus, but is produced by the concussion of the explosion upon the delicate recording levers. The response is shown in the change in level of the lines following the stimulus. In more than a dozen attempts to record reactions to the sound of a shot in this manner, the results were for the most part negative.

In Figure 7, the response to a shot from a .32-calibre revolver fired two feet distant from the outer surface of the abdominal wall, is recorded. The abrupt vertical movement of both abdominal lines is not a fetal response, but is a mechanical effect produced by the concussion of the explosion upon the delicate recording levers The response itself is shown by the changes in the curves following the sharp deflection caused by the explosion In more than a dozen attempts to produce an observable startle reaction in the fetus to a stimulus of this sort, the results were for the most part negative The record pictured shows the most "violent" response which was obtained [3]

2. *Quantitative Results The Graphometer Method*

Several quantitative methods of evaluating the activity of the fetal organism were attempted Two of these will be discussed in the present report. The first made use of the Indiana graphometer, a special device for measuring the oscillations of wavy lines or curves The second was based upon straight-line measurements of the records, made with the aid of mechanical drawing instruments and a magnifying glass.

Since the Indiana graphometer has been fully described elsewhere (2), a detailed explanation of its operation and construction will not be given at this point. It is sufficient to say here that the instrument is a combination of two planimetric units mounted together on a movable arm and equipped with special ratchets which limit the rotation of each unit to a direction opposite to that of the other. As the operator moves the pointer of the graphometer over the line to be measured, the two planimetric units automatically summate the vertical deflections or deviations of the line from a horizontal base One unit gives the sum of the deflections in an upward direction from the horizontal, while the other unit summates the lengths of the downward deflections from the horizontal If the upward and downward deflections are added together, the result is a measure of the total activity or total movement within any given time interval By proper adjustment, the instrument can be made to correct for the arc of the writing pointer which originally traced the line whose vertical oscillations are measured. Readings are taken in centimeters of vertical deflection (on the record) from the horizontal baseline

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[3] Sontag and Wallace (8, 9) report fetal responses to sound stimuli in many observations on a number of different fetuses A serious question concerning their experiments, however, is whether the stimuli received by the subjects were auditory or were actually tactual in nature

Records of gross or total activity as measured by the graphometer are given in the upper part of Table 1.[4] No differentiation has been made in this table between rostral and caudal readings, but the two have been combined to give a single measure of general activity The figures in the table are the average graphometer readings per minute for the different fetal age periods Each age period covers 10 days of fetal life, excepting the last which includes only seven days. Yet the averages are directly comparable Although the variability, as represented by the sigmas of the distributions, are large in almost every case, a marked and unmistakable trend toward increased activity as the fetus develops is brought out by these data

TABLE 1

AVERAGE GRAPHOMETER READING AND NUMBER OF MOVEMENTS PER MINUTE—OBJECTIVE DATA

Fetal age in days	170-179	180-189	190-199	200-209	210-219	220-229	230-239	240-249	250-256
Av graphometer reading per minute of observation	30	17	60	1.38	78	1.28	1.20	1.88	1.16
σ	21	.12	25	60	62	26	55	75	36
Av. number objective movements per minute*	1.99	1.24	4.41	9.27	5.13	8.67	7.33	10.19	5.39
σ	1.81	68	1.98	3.94	4.33	2.21	3.86	4.30	1.91

*See text for definition of "an objective movement"

3 *Tabulation of Arbitrary "Movements"*

The second method of analyzing the records (without the use of the graphometer) was to determine the number of arbitrarily-defined movements which occurred. A "movement" by this method was regarded as a change of specified magnitude occurring within a fixed time limit. Changes in the activity lines smaller than the minimum required by the definition of a movement, were not counted. Also slow or gradual alterations in contour (which might actually be "big" movements, if observed over periods of several minutes) were eliminated, because the amount of change which occurred within the time limit was not sufficient to satisfy the requirements of "an objective movement."

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[4] Uterine contractions were, of course, omitted from these figures

This procedure, in effect, draws a sharp line between "slow" and "fast" abdominal changes, and excludes the slow changes from the results. The advantage of making such a distinction is that it eliminates those alterations in abdominal contour which are produced by the slow-acting smooth-muscle of the maternal uterus (i.e., uterine contractions), as well as any possible changes caused by the smooth-muscle tissue of the amniotic sac (*vide supra*). What is left is the more rapid striped-muscle behavior of the fetus uncomplicated by disturbing influences. If the arbitrary-movement procedure is properly applied, therefore, it should serve as an additional control, for it should automatically exclude these irrelevant factors from the final measurements, which would then be based upon fetal activity alone. The rules governing the technique as it was employed in the present instance, were as follows.

1. "A movement" was taken to be any vertical displacement of the recording line (either upward or downward) greater than 5 mms. which occurred within a period of 10 seconds.

2. Displacements of less than 5 mms. were not counted, except when several minor changes, each less than 5 mms. in extent, totaled 5 mms. or more, within a 10 sec. interval. In such a case the various small displacements were counted as ONE movement.

3. When a displacement was greater than 5 mms. it was considered to be all the same movement, until there was a definite change in the direction of the line of at least 90 degrees.

4. A movement beginning in one minute and ending in the next was tabulated as being in the minute in which it ended.

In the lower part of Table 1 are given the average number of "movements" per min. for the different fetal ages, as determined by this method. Although the variabilities are again large, the results show the same definite increase in activity with age. The total number of objective movements—as arbitrarily defined by this procedure—was 10,469. That is, 10,469 "movements" occurred within the somewhat less than 30 hours of recorded observation (1730 minutes) from the 170th to the 256th day of fetal life

The close correspondence between the two methods of measuring gross or generalized activity can be seen from Figure 8, which has

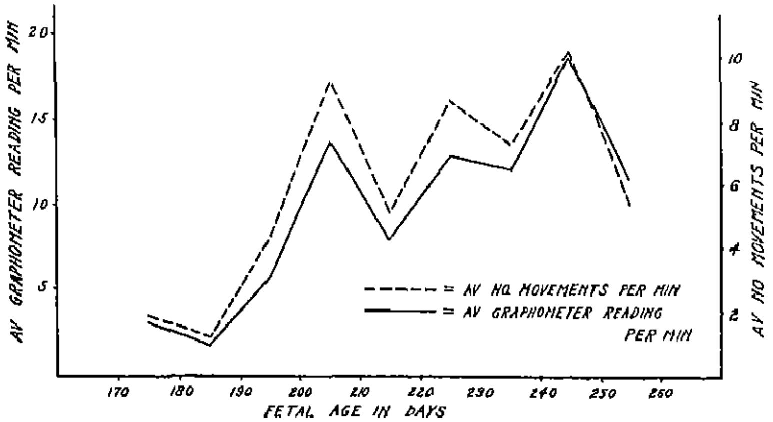

FIGURE 8

INCREASE IN FETAL ACTIVITY WITH AGE

The graphs show the rate at which gross motility develops, from the 170th to the 256th day of fetal life Activity records were taken at approximately daily intervals by the method illustrated in Figure 1 The points plotted in the graphs are averages for each 10-day period, excepting the last point, which is an average of seven days The graphometer results shown on the left-hand vertical coordinate were obtained by tracing the activity lines with a special instrument, the graphometer, which automatically totals the deflections of the recording markers Readings from the graphometer serve as an index of general behavior The average number of movements per minute which are given on the right-hand vertical coordinate, were obtained by measuring the general activity records by a special procedure described in the text The two methods, though quite different, give strikingly similar graphs of the increase of motility with fetal age

been made up from the data in Table 1 Here the average number of movements per min, and the average graphometer activity per min have been plotted against age, on comparable scales. Even the minor fluctuations of the curves from one age period to the next are faithfully reproduced by each of the methods The drop in the level of the curves for the 250-256 age point suggests a confirmation of the finding of Richards, Newberry and Fallgatter (4), who have reported that "there is a peak of activity during the eighth and ninth lunar months, with a dropping off at the tenth month" (4, p. 78).

4. *Localized Activity*

Perhaps the simplest and most direct way to show the greater relative activity of the head-and-shoulder region at the younger ages and the subsequent lessening of the relative activity in these parts, is by means of the figures in Table 2. The data presented are all based upon average graphometer readings per min. for both upper and lower curves. Yet they are all per cents and hence are relative. They give no indication of the amount or change in absolute activity which is brought out in Table 1. The figures show the percentage of the total number of observation periods of *ca.* 18 min. each, within each age group, during which rostral activity exceeded caudal activity. A percentage of 100 would mean that, in every one of the 18-minute experimental sessions for any age period, the activity of the head-end of the fetus was greater than the activity of the sacral and leg region. A percentage of 50 would mean that during half of the observation periods for the age group under consideration, the average activity of the rostral end exceeded that of the caudal end; and for the remaining half of the observation periods within the same age group, the activity of the caudal end exceeded that of the rostral end. It will be noted from the table that between the

TABLE 2

PERCENTAGE OF OBSERVATION PERIODS IN WHICH THE AVERAGE ACTIVITY OF THE ROSTRAL END OF THE FETUS PER MINUTE EXCEEDED THE AVERAGE ACTIVITY OF THE CAUDAL END OF THE FETUS PER MINUTE—OBJECTIVE DATA

Fetal age in days	170-179	180-189	190-199	200-209	210-219	220-229	230-239	240-249	250-256
$\frac{x}{y}$ (for 10-day intervals)	66.6	77.7	92.9	91.7	72.7	41.7	69.2	37.5	50.0
$\frac{x}{y}$ (for 30- and 27-day intervals)		81.3			68.6			55.6	

x=Number of observation periods in which the average activity of the rostral end of the fetus per minute (as measured by the graphometer) exceeded the average activity of the caudal end of the fetus per minute.
y=Total number of observation periods.

ages of 220-229 and 240-249 days *respectively*, *caudal activity actually* exceeded rostral activity, since the percentages obtained were both below 50. The percentages for the longer (30- and 27-day) periods of 81.3, 68.6 and 55.6 show a regular increase in the relative activity of the caudal end as the fetus develops.

The degree to which the *absolute* amount of activity between the rostral and the caudal portions of the fetus were related, is shown by the product-moment correlation coefficient of +.53 ± .05 between the graphometer readings for the upper and lower curves for the 94 periods of recorded observation. Since the size of this correlation coefficient is well above 4 times its *PE* there can be no doubt of the positive relationship it indicates.

5. *Subjective Data*

The introspective observations of the mother on felt or experienced movement show further relationships with reference to fetal behavior which are of some significance. These have proven of especial value in connection with problems of timing and duration of reactions. Since the mother's key was held down during all felt movements, the introspective line gives sharp demarcations between periods of experienced activity and quiescence. It is a simple matter *to tell from the introspective tracing, exactly when a movement* began to be felt and when it went below the threshold of the mother's experience.

TABLE 3

Average Number of Felt Movements per Minute and Duration of Movements—Subjective Data

Fetal age in days	170-179	180-189	190-199	200-209	210-219	220-229	230-239	240-249	250-256
Av. number felt movements per minute	3.30	1.72	2.27	1.43	1.12	1.75	.88	.99	.80
σ	1.25	.37	.64	.51	.52	.37	.53	.43	.31
Av. duration of felt movements in seconds	3.95	10.95	8.43	21.50	18.75	14.81	31.29	41.31	32.53
σ	2.69	5.40	5.51	13.85	9.13	3.97	17.64	27.06	8.56

Some of the relationships observed from the introspection data are shown in Table 3, which gives the average number of felt movements and the average duration in sec of each movement It should be clearly noted in connection with this table that a movement, subjectively considered, is very different from the arbitrarily defined objective movements which have already been presented in Table 1 and again in Figure 8 Subjective movements might be either short discrete reactions, or bursts of continuous activity lasting for a minute or even longer When the activity was continuous there was no clear introspective way of breaking it up into separate units As a result, an introspective movement began with a depression of the signal marker and ended when that marker had returned to its normal baseline There were, in all, 2,653 felt movements of this sort recorded—a figure considerably less than the 10,469 arbitrarily defined objective movements which have already been discussed

According to the data in Table 3, the average *number* of felt movements per min *decreased* with fetal age, whereas the average *duration* of felt movements *increased* from 3 95 sec to 41 31 sec. in the 240-249 age period. The seemingly paradoxical fact that the number of fetal movements *decreased* with age is explained by the progressive lengthening of the individual movements, or bursts of activity. Hence as the fetus grew there were fewer discrete activity periods—separated by intervals of quiet—within any fixed time limit The variabilities are so great that few of the averages can be considered statistically significant when compared to the adjacent averages, but the trends are consistent and unmistakable. The product-moment correlation coefficient between the *absolute* number of objective and the *absolute* number of subjective movements was —19 ± .07

The relationship between the number and duration of experienced movements is graphically depicted in Figure 9, which is plotted from the data of Table 3 The curve for the duration of felt movements which rises from left to right, is strikingly similar to the curves in Figure 8, which were obtained from the abdominal recording devices. The close agreement between these graphs may be taken as a kind of measure of reliability of the whole procedure. It also speaks well for the quality of the introspective observations which were furnished

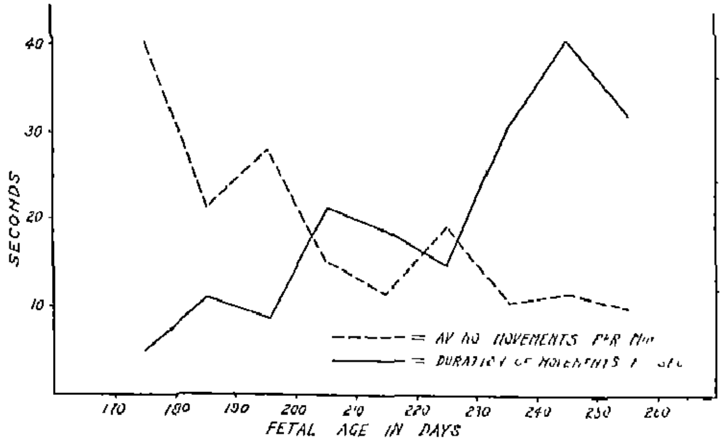

FIGURE 9

Curves Plotted from Introspective Data, Showing the Duration and the Number of Movements Experienced by the Mother with Increase in Fetal Age

All points are averages for periods of 10 days, excepting the last which is an average for seven days The movements recorded in this figure are not the same as the arbitrarily-defined objective movements shown in Figure 8 An introspective "movement" was not infrequently a continuous burst of activity lasting a minute or more The graphs show that the number of distinct periods of activity of this sort which were experienced per minute, decreased with fetal age, whereas their duration increased The curve for the duration of movements (solid line) is much the same in general form as the objective activity records shown in Figure 8 The close correspondence between these graphs may be taken as a kind of measure of the reliability of the whole procedure

6 *Activity-Inactivity Ratios*

What proportion of the time was the fetus active and what proportion of the time was it inactive? And how do these proportions vary with fetal age? The answer to these questions will be found in Table 4, which was derived from introspective data. Results given in this table show that the percentage of the total time of observation in which the fetus was active approaches and even exceeds 50 0 after the 200th day The percentages are considerably less before this age Activity-inactivity ratios given in Table 4 bring out the same facts in somewhat different form A ratio greater than 1 00 indicates that the organism spent more time in activity than it did in inactivity, during the periods of observation at the age

TABLE 4

COMPARISON BETWEEN TOTAL TIME SPENT IN ACTIVITY AND TOTAL TIME SPENT IN QUIESCENCE—SUBJECTIVE DATA

Fetal age in days	170-179	180-189	190-199	200-209	210-219	220-229	230-239	240-249	250-256
Percentage* of time active	21 2	31 3	31 3	51 1	34 9	42 5	45 6	67 6	43 4
Activity-** inactivity ratio	27	46	46	1 04	54	74	84	2.08	77
σ of ratio	.16	37	32	1 53	70	20	1 10	2 12	30

$$* = \frac{\text{Time spent in activity}}{\text{Total time of observation}}$$

$$** = \frac{\text{Time spent in activity}}{\text{Time spent in inactivity}}$$

level in question. It is to be remarked that the data in Table 4, if plotted in graphical form, would give curves similar to those already presented in Figures 8 and 9.

D SUMMARY

The present paper describes a method for objectively recording the gross motility of the human fetus *in utero*. The method is mechanical rather than electrical or pneumatic Two light metal plates are fitted over the maternal abdomen in such a way that they tilt whenever the contour of the abdomen is changed by pressure from within. Appropriate recording devices transmit these tilts to a kymograph The apparatus is simpler than many devices which have previously been used, yet it permits separate behavior-records of the caudal and rostral ends of the fetus and it automatically eliminates from the activity-lines, the disturbing effect of the mother's respiration

As a test of the method a total of 1730 minutes of objectively recorded observations upon one normal fetus have been accumulated and analyzed. Records of approximately 18 minutes duration were taken at a constant time each day, from the 170th to the 256th day of fetal life Fetal ages were computed from the estimated time of ovulation Changes of the abdominal contour produced by uterine contractions or by contractions of the smooth-muscle tissue of the amniotic sac, were eliminated from the records of fetal movement by a special technique. Following are some of the findings which an examination of the data has brought to light.

1. Although the variability in the amount of recorded movement from day to day was large, spontaneous activity as registered by the present technique showed a regular increase with fetal age.
2. Between the ages of 170 and 199 days, the head or rostral end of the fetus was more active than the leg or caudal end in 81.3 per cent of the observation periods.
3. Between the ages of 220 and 256 days, the activity of the rostral end exceeded that of the caudal end in only 55.6 per cent of the periods of observation.
4. The introspective data furnished by the mother as to the extent and duration of fetal movements, closely paralleled the objective data, wherever it was possible to compare the two.
5. The number of discrete and separable periods of activity experienced by the mother decreased with fetal age, but their average length increased from about 4 to about 33 sec. from the 170th to the 256th days.
6. During the early periods of observation, the fetus was active only about one-fourth as much time as it was inactive. But during the periods from the 240th to the 249th days, it was active more than twice as much as it was inactive.
7. The reactions of the fetus to the sound of a .32-calibre revolver fired at a distance of two feet were progressively tested. In only one instance (at the fetal age of 234 days) was there any evidence of a responding movement.
8. The method described should be readily applicable to the study of conditioning in the human fetus, and to other problems where it is desirable to record automatically, gross fetal reactions.
9. If data from a sufficient number of cases can be accumulated by this method, it should be possible to establish norms or standards of prenatal behavior for different fetal ages.
10. As an interesting speculation upon future observations, it is suggested that the existence of prenatal norms of behavior might ultimately make possible the diagnosis of abnormalities, sickness, or even feeblemindedness, before the advent of birth.

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The Journal of Genetic Psychology, 1941, 58, 327-351

THE DEVELOPMENT OF VISUAL SIZE CONSTANCY IN EARLY INFANCY[*]

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A. INTRODUCTION

Among the questions which have long been of interest in perception is that of the establishment of constant responses to a perceptual object despite variations in certain of the properties of the stimuli acting upon the receptor organs. One particular problem in this connection is that of the development of a constant response with respect to the size of a given body although the projective size of the object (or the size of the proximal stimulus, the retinal image, or the visual angle) may vary considerably according as the object is near or far from the eye. Knowledge concerning this phenomenon of visual size constancy is by no means limited to recent times, and the discrepancy between the apparent (phenomenal) size of an object at a distance from the observer and the projective size has been studied by a number of investigators who have gathered a sizable body of facts.[1]

Our concern at the present time, however, is not with the general problem of size constancy in perception, its limits or causal factors; rather we are interested in the genetic development of this phenomenon, a question which lies as a special aspect of the general problem of the constitution of a spatially organized "world of things" While this question might be studied from a number of different points of view, the topic proposed for study in the present work is whether this particular phenomenon is present in the perceptual reactions of the infant The investigation deals with the problem of perceptual size constancy stated in a more elementary and, in one sense, more negative form than that of the problem of visual size constancy as usually stated The study treats the development of discriminatory responses to objects at varying distances and of varying body size although the size of the retinal image remains the same.

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[*] Accepted for publication by Leonard Carmichael of the Editorial Board, and received in the Editorial Office on January 2, 1940.

[**] The work reported here was carried out in the Psychological Institute of the University of Vienna while the writer was the Abbott School Alumnae Fellow of Pembroke College in Brown University. The writer acknowledges her indebtedness to Professor Leonard Carmichael, President of Tufts College, formerly Director of the Laboratory of Psychology at Brown University, for advice in the study; to Dr. Egon Brunswik, Assistant Professor of Psychology at the University of California, formerly Privat-Dozent at the University of Vienna, for direction and planning of the experiment; to Professors Karl and Charlotte Buhler in whose laboratory the work was carried out; to Dr. Liselotte Frankl, for suggestions regarding the observations.

[1] A brief English summary of some of these data and further references may be obtained in the publications of Locke (19, 20) and Sheehan (28).

B PREVIOUS STUDIES OF VISUAL SIZE CONSTANCY IN CHILDREN

The evidence concerning the problem of size constancy in children is limited Anecdotal references to perceptions of early childhood may be found. For example, Helmholtz (16) relates mistaking human beings on the belfry of a church for dolls. Koffka (18) likewise cites just such an experience in which he perceived the lower cannon barrels on a tall monument as being short rifles and the higher ones as small pistols It should be noted in connection with these examples that the distances involved and the direction of regard do not belong to the usually experienced distances of the child Hence such illustrations do not closely relate to the problem of visual size constancy for bodies fairly near at hand

Stein's observation (31) of his son, aged seven months, grasping eagerly for a small doll-sized bottle has been interpreted by Koffka (18) with Stein's agreement that the illustration does not bear directly upon the question of perceptual size constancy but indicates that "size" is relatively inaccurately perceived and unimportant in the child's perceptions

Several experimental investigations using children as subjects have been made directly upon the problem of size constancy The work of Frank (12) was carried out with 30 children of ages ranging from 11 months to 7 years The children were trained to choose the larger of two boxes Under conditions wherein the size of the retinal image for the larger box was actually smaller than that for the smaller box, the children chose the larger box with a high consistency of performance

Beyrl (1) working with 55 children from 2 to 10 years of age found size constancy to show a slight developmental trend with increasing age When his data are interpreted with the Brunswik

C VISUAL AND VISUAL-MOTOR DEVELOPMENT OF THE INFANT

A brief mention should be made of the results obtained in studies of visually controlled responses in the human infant in order to make clear the general problem of perceptual development of which size constancy is but one special aspect The experimental work which has been carried out by numerous workers on the question of the visual responses of the neonate shows that the visual mechanism is well equipped for certain types of visual responses[8] Pupillary reflex, palpebral reflex, optic nystagmus, and the oculocephalogyric reflex can be demonstrated for the neonate Following a moving object with eyes and then the head, fixating a distant object, blinking to threat of approaching object, accommodating and converging the eyes occur at a later age, but the median age for appearance falls as a rule within the first two months of postnatal life The field of vision for the young child is probably limited to a very small area, at least for light patterns of not too great intensities Stern (31), for example, limits this field as being a hemisphere of a radius of approximately one-third meter. To what extent this area is lacking in three dimensional space characteristics for the young baby is not agreed upon. Rasmussen's analysis (26) suggests that the child apprehends everything as being in one plane He states that "perspective does not exist for the infant, but must be acquired by experience As perspective rests on differences in distance, this means that the child must gradually learn that objects, and parts of objects, lie at different distances, and that this is the reason why they look as they do" (26, p. 47-48)

More complex reactions involving vision make their appearance still later These include such behavior items as watching the hands, staring at strangers, beginning to recognize facial expressions of other people, and reaching for objects visually perceived. Very important among the visual responses necessary for size constancy in perception is, of course, a discriminatory response to distant objects. Investigation of this problem is still inadequate, and we must rely largely upon biographical reports A few of these are mentioned Major (21), for example, found that his son reached for a distant object at 134 days and again at 141 days. On the 146th day there was no reach for an object at a distance of two feet, but there was a reach if the object were almost within reach Moore's son reached for things within range at 57 days but not for objects outside reaching range (22). Sully (32) reports a child not reaching for objects outside the reaching range at six months. Stern (31) also reports this, noting that the arms are held out wide apart until the object is nearly within reach when the arms are brought in upon the object. Stern states that "even in the first six months, the distinction between 'near' (within reach) and 'far' (beyond reach) comes into being as the earliest optical apprehension of depth" (31, p. 119).

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[8] For details see, for example, the review of Pratt (25) and Munn (23)

In Shirley's study (29) of 25 infants during the first two years of life, she records the percentages of babies from the ages of 13 to 23 weeks who reached for a bell within range and out of range. Between the ages of 13 to 19 weeks, the percentage of reaching out of range was below 10 per cent. From 19 weeks on there was an increase in reaching out of range which was at its highest at 22 weeks, occurring in approximately 70 per cent of the cases. At 23 weeks, 100 per cent of the children reached for the bell within range. Shirley states that "the babies under 6 months reached for a toy that was out of range even though they seemed to recognize that it was beyond their grasp" (29, p. 163).

In Piaget's observations (24) of his children he notes gross errors in reaching for objects during the four and five months' periods. This, he suggests, is partially the result of a lack of stabilization *of the pupillary response and binocular convergence. However, he* likewise points out that the perception of depth is dependent upon the acquisition of a number of perceptual experiences which are organized into a more general perception of depth.

Buhler and Hetzer (5) in their inventory of infant behavior also speak of infants reaching with simultaneous unsteady movement of both arms at four months for objects in the immediate vicinity. At the beginning of the second half year, the child reaches for all seen objects with arms and feet. This is probably to be compared with the type of reaching out which Shirley measured and Stern mentions rather than a reaching in which there is a closure of arms and hands in the median frontal position of the body which would allow a contact between hands and object.

In summary of these reports it would seem then that gross errors in reaching occur before six months. The child after six months may make approaching movements, but most of the workers seem agreed that this reaching response occurs with recognition of the distances involved.

The period of two, three, four, five, and six months witnesses a rapid development in perceptual reactions, and it would seem that there would be more possibility of detecting the presence or absence of size perception dependent upon visual angle during this period if any such dependence could be found While this fact has probably been recognized by those interested in the development of visual size constancy, a direct attack on the problem has not been made The failure to do this has depended upon the lack of very clearly defined responses which would indicate thereby some discrimination of the visual stimuli on the part of the infant Several studies of "object" perception in infancy have suggested a method, which, while not giving complete unequivocal results, still presents a step towards the solution of the problem The work of Rubinow and Frankl (27), for example, has shown it possible to obtain some information concerning the genetic development of the perception of objects These investigators have used a general survey of the behavioral responses of the infant when presented with a bottle (or with an object which may have had one or more characteristics of a bottle, e g, a pointed cone) The use of the bottle, as they point out, is a particularly suitable object since it is probably one of the first objects recognized by the infant, but its use in a study of size constancy incorporates an additional complicating factor, namely, variations depending upon the degree of hunger of the child A situation which would call forth less complicated responses would obviously be more desirable for a study of size constancy

The reaching response has been suggested by several workers in the field of infant behavior as a response which might prove of value in analyzing the perceptual reactions of the infant, and has been used by Staples (30), for example, in an analysis of color discrimination in infants This particular response in its general setting of head and eye movement and other bodily response which might involve bringing the infant towards or away from the object was the one selected for the behavioral indicator in the present study

The use of the hand and arm in obtaining and manipulating an object shows a fairly constant growth development which has been studied by a number of observers The reader is referred to the following summaries which, among others, give a general picture of these responses (5, 14, 15, 8, 29) In Section *E* 2 of the results given below, a comparison of the reaching responses of the subjects of the present investigation may be found

D. CONDITIONS OF THE PRESENT INVESTIGATION

1. *Subjects*

The present study was carried out during the winter and spring of 1936-1937 at the Kinderuebernahmestelle in Vienna, Austria, where one part of the Psychological Institute of the University of Vienna was located. In all 73 children from the ages of 10 weeks to 50 weeks were examined. Since the children at the Kinderuebernahmestelle remained there for a brief period of time, it was possible to make a number of observations upon the same child. However, since the length of residence was not definite, the number of repeated observations of each child varied considerably. Likewise occasional periods of illness, as well as failure of the examiner to meet the routine schedule of the child, prevented a number of observations from being repeated daily during the presence of the child in the institution. The number of children, their ages at the beginning of the observations, the number of weeks in which tests were given, the total number of observations and, where the data are available, birthweights and weights at the beginning of the experimental observations are given in Table 1. The children used in the present investigation presented no serious disease symptoms. Their weights may be compared with the average weights given by Buhler (4) from data of Pirquet where 3,000 grams is listed as average birthweight and the developmental increment is 1,000 grams added for each succeeding two months.

2. *Observation Situation*

The observations were carried out in the room in which the infants lived. Such a room contained from four to six cribs arranged on two sides of glass walls. A third wall with glass partitions opened onto a long daylight illuminated corridor, and the fourth wall contained windows to the outside. Except for the children of nine to ten months who could move about in their beds, there was little in the child's visual field to distract the child. The infants were seldom assisted to a sitting position so that the infants had had little opportunity for watching except as they lay in the supine position.

The observations were made at a time of the morning when relatively few interruptions by the attendants occurred. In general, the conditions of the observations, while obviously not ideal experi-

TABLE 1

The Number of Children, Age at Time of Observations, Total Number of Observations, Birth Weight, and Weight at Time of First Observation for Children of Group I and Group II*

Group I							Group II						
Subject	Sex	Initial age—weeks	No weeks observed	Total days observed	Birth weight—grams	Weight at observation	Subject	Sex	Initial age—weeks	No weeks observed	Total days observed	Birth weight—grams	Weight at observation
1	F	13	3	10	2950	4050	40	F	10	1	1	—	—
2	M	13	1	5	3250	5055	41	F	10	5	7	—	4800
3	M	14	11	34	2700	3800	42	F	10	5	5	—	—
4	M	14	3	8	3050	4000	43	F	11	8	8	—	4700
5	M	16	10	26	—	5900	44	M	12	7	17	—	4200
6	M	16	1	1	—	3750	45	M	12	4	5	—	5200
7	F	17	1	1	3300	5230	46	M	13	4	6	3650	6100
8	F	17	5	15	—	6200	47	F	13	4	4	—	—
9	F	18	10	40	—	5600	48	M	13	8	10	3680	5300
10	F	18	3	8	3500	5550	49	M	14	2	3	—	5400
11	M	19	2	9	3100	6900	50	M	15	1	1	—	—
12	M	20	4	17	2800	5300	51	M	15	8	10	2900	6100
13	F	21	1	1	3000	5750	52	M	15	4	6	3000	5340
14	M	22	6	24	—	6850	53	M	15	6	12	—	—
15	M	24	2	4	—	7100	54	F	15	5	5	2800	5800
16	F	24	2	7	2880	5900	55	M	17	1	2	—	5600
17	M	25	1	1	3200	6640	56	M	19	1	1	—	5800
18	M	25	7	23	3700	8550	57	M	19	6	9	—	6800
19	M	28	6	25	2500	7100	58	F	20	3	3	—	4400
20	M	29	6	27	—	5350	59	M	20	1	1	4078	—
21	M	30	6	15	3500	8250	60	M	21	1	1	—	7500
22	M	32	2	6	—	6550	61	M	22	3	3	3390	6500
23	M	32	3	11	2350	7600	62	M	22	1	1	—	7200
24	F	33	1	4	—	7350	63	F	22	6	9	—	—
25	M	34	1	1	—	—	64	F	23	3	3	—	5860
26	M	35	1	1	3500	7220	65	F	23	3	3	—	7430
27	F	35	2	2	3000	7600	66	M	24	1	1	—	8100
28	M	36	1	1	—	6400	67	F	24	1	1	3400	8200
29	F	36	4	13	—	8100	68	M	24	3	3	—	5200
30	F	39	1	1	2900	7000	69	F	26	2	2	—	5900
31	M	40	1	2	4050	7400	70	M	27	1	1	2850	7100
32	M	42	1	2	3150	7600	71	F	29	4	10	—	6700
33	M	42	2	6	—	8700	72	M	32	1	1	—	7400
34	M	43	2	2	—	9500	73	M	34	1	1	3250	—
35	M	44	1	1	2850	8000							
36	F	46	2	3	—	—							
37	F	46	1	2	—	—							
38	M	47	1	3	—	7200							
39	F	49	2	3	3000	9100							

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*For difference between Group I and Group II, see the discussion under *Procedure* mental conditions, were excellent for the type of study desired, since the conditions presented a relatively large number of natural distance cues for the child but were on the other hand sufficiently uniform for all the children to make comparison possible.

3. *Procedure*

The situation in which the observations were made consisted in the separate presentation before the baby of two rattles at different distances from the eye. Figure 1 shows the two rattles. The infants were lying in the dorsal position in their cribs. A small rattle of 19 centimeters length was presented to the baby at a distance of 25 centimeters from the eye so that a line from the center of the rattle to the eye *would make an angle of approximately* 40 degrees with the edge of the bed (Situation *A*). The same rattle was held at a distance of 75 centimeters from the eye in Situation *B*. In Situation *C* a rattle three times as large as the small rattle but of the same form and coloring was shown at the farther distance. Thus the gross extension and quality of the retinal stimulus set up by the objects was the same in Situations *A* and *C*. The time of presentation was 30 seconds. Protocolled records of the infant's behavior were made for each stimulus situation.

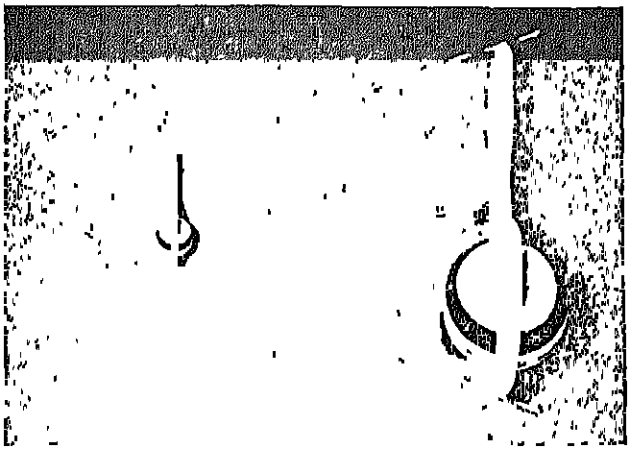

FIGURE 1

PHOTOGRAPH OF THE RATTLES AND THEIR RELATIVE DISTANCE FROM THE EYE

With the children in Group I, *E* stood at the edge of the crib to the rear of the child and in sight of the child only if the infant turned its head. Stimulus presentations for one day's observation consisted in four presentations of each of the three situations mentioned If, in Situation *A*, the child's hand came in contact with the rattle, no removal of the rattle was made

With the children in Group II, a white screen attached to the edge of the crib prevented the infant from seeing the experimenter. Before each group of presentations of the rattles in the three positions, the examiner stood beside the infant and presented the small rattle to the baby allowing the baby to touch and manipulate the rattle for a period of one minute if it could do so (play situation) Stimulus presentations for one day's observations in Group II consisted in six presentations of each situation. The order of presentation of the three positions of the rattles was rotated

E Results

1. *Responses in the Three Situations*

The results of the investigation may be presented first in terms of the similarity of the infants' responses to the three situations Insofar as the reactions to Situation *A* (small rattle near), Situation *B* (small rattle far), and Situation C (large rattle far) are similar, it might be assumed that there is no discrimination among the various situations either because the experimental situation does not require it or because the child can make no such discrimination. Insofar as the responses to Situation *B* and Situation *C* are similar, but not similar to those of Situation *A*, it might be assumed that the factor of distance is more dominant and that retinal size is of less significance Finally, equal reactions to Situations *A* and *B*, but lack of equivalence for Situation *C* would represent a step towards the positive aspect of size constancy, that is, identity of reaction to physically equal bodies at whatever distance they may be located in the near environment of the child The negative aspect, that is, whether there is a non-equality of responses to Situations *A* and *C* is the crucial point in the present investigation since it probably indicates a step towards the equivalence of Situations *A* and *B*

The protocols for each stimulus presentation were reviewed, and the number of similar responses for each situation was obtained for each subject in each age group of two-week intervals The quali-

TABLE 2

THE NUMBER AND PERCENTAGE OF RESPONSES* OBTAINED FOR THE THREE PRESENTATIONS OF THE RATTLES IN THE NEAR AND FAR POSITIONS

Age in weeks	Number of subjects			Total number of trials			Situation *A* small rattle near						Situation *B* small rattle far						Situation *C* large rattle far					
	Series I	Series II	Total	Series I	Series II	Total	Series I		Series II		Total		Series I		Series II		Total		Series I		Series II		Total	
							f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
10-11	—	4	4	—	21	21	—	—	11	52	11	52	—	—	3	14	3	14	—	—	1	5	1	5
12-13	2	11	13	8	102	110	6	75	45	44	51	46	3	38	17	17	20	18	4	50	21	21	25	23
14-15	7	16	23	54	127	181	37	69	76	60	113	62	25	46	32	25	57	31	29	54	35	28	64	35
16-17	8	18	26	63	118	181	57	90	65	55	122	67	26	41	21	18	47	26	36	57	30	25	66	36
18-19	9	14	23	81	94	175	68	84	68	72	136	78	20	25	25	27	45	26	25	31	37	39	62	35
20-21	13	12	25	142	88	230	137	96	79	90	216	94	37	26	18	20	55	24	40	28	29	33	69	30
22-23	9	13	22	88	84	172	87	99	83	99	170	99	17	19	17	20	34	20	14	16	20	24	34	20
24-25	12	10	22	77	77	154	75	97	77	100	152	99	11	14	9	12	20	13	10	13	10	13	20	13
26 27	6	7	13	42	48	90	38	90	48	100	86	96	8	19	5	10	13	14	6	14	8	17	14	16
28-29	5	2	7	29	8	37	28	97	8	100	36	97	5	17	3	38	8	22	3	10	3	38	6	16
30-31	8	2	10	70	36	106	69	99	36	100	105	99	0	0	8	22	8	8	1	1	7	19	8	8
32-33	10	1	11	83	6	89	83	100	6	100	89	100	3	4	0	0	3	3	4	5	0	0	4	4
34-35	7	—	7	33	—	33	33	100	—	—	33	100	2	6	—	—	2	6	2	6	—	—	2	6
36-37	4	—	4	10	—	10	10	100	—	—	10	100	0	0	—	—	0	0	0	0	—	—	0	0
38-39	3	—	3	24	—	24	24	100	—	—	24	100	0	0	—	—	0	0	0	0	—	—	0	0
40-50	10	—	10	48	—	48	48	100	—	—	48	100	0	0	—	—	0	0	0	0	—	—	0	0

*See Section E1 for a discussion of how the responses were judged tative aspects of the response varied widely for the various age groups in the total study as, of course, would be expected, but for any given day's observations, the criterion for a response was similarity to those responses in the play situation in observations of Series II or in the near situation of Series I which could be considered as an adjustment to the rattle

Table 2 presents the number of subjects for each age group, the number of trials for each situation, and the number and percentage of responses for the observations of Series I and Series II It will be noted that response to Situation *A* for the youngest subjects between 10 and 14 weeks approximates 50 per cent, while from the ages of 20 weeks and following, that is, approximately five months and over, there is a response to Situation *A* in over 90 per cent of the cases In Situations *B* and *C* the number of responses is always less than the number in Situation *A* As the number of responses for Situation *A* increases, so also do those for Situations *B* and *C* for the periods until 16 weeks for Situation *B* and until 18 weeks for Situation *C*, that is, just before and after four months of age

The interrelationship between the relative number of responses can be seen by comparing results for Situations *B* and *C* to those for Situation *A* at the various age levels Representative scores of this kind have been computed by expressing the number of responses to Situations *B* and *C* separately in terms of percentage of responses to Situation *A* at a given age level. Thus the curve for Situation *A* is transformed into a horizontal line at 100, furnishing the reference line for Curves *B* and *C* Should *B*, but not *C*, approach the level of *A* (100), this would give an indication of high degree of perceptual size constancy Should *C*, but not *B*, come close to 100, this would mean that retinal vision was more dominant, that is, a lack of size constancy Should *B* and *C* be close together but not approach 100, this would indicate a high degree of specificity of response to certain distances

Table 2*a* and Figure 2 show this interpretation As can be seen, the percentage of responses given in Situations *B* and *C* decreases when compared with the corresponding number of responses given in Situation *A* This indicates an increasing differentiation of *B* and *C* from *A* There are no striking differences between the number of responses given to Situations *B* and *C*, and what difference there is, consistent in trend but not statistically significant, seems to decrease as age increases This together with the general fall in both

TABLE 2a

RESPONSES TO SITUATIONS *B* AND *C* IN TERMS OF PERCENTAGE OF RESPONSE TO SITUATION *A*

	Series I		Series II		Total	
Age	Response in % *B*	Response to *C*	Response in % *B*	Response to *C*	Response in % *B*	Response to *C*
10-11	—	—	27	9	27	9
12-13	50	67	38	17	39	19
14-15	68	78	42	46	50	57
16-17	46	63	32	16	39	54
18-19	29	37	37	54	33	46
20-21	27	29	23	37	25	32
22-23	20	16	20	24	20	20
24-25	15	13	12	13	13	13
26-27	21	16	10	17	15	16
28-29	18	11	38	38	22	17
30-31	0	1	22	19	8	8
32-33	4	5	0	0	3	4
34-35	6	6	—	—	6	6
36-51	0	0	—	—	0	0

curves indicates an improvement in response to distance, a response independent of size of the bodies or the retinal stimulus value of the bodies located at the distances involved. In other words, it indicates improvement in depth perception.

However, it must also be noted that, although there is no marked difference between *B* and *C*, the scores are, on the whole, slightly higher for *C* than for *B* for the periods up to about five months. This may indicate a slight degree of prevalence of retinal vision, since *C* is treated more like *A* than *B*. More convincing evidence than the massed quantitative data is the way in which the child sometimes approached the large object at a distance. With both arms moving, but with the eyes following one hand, the child seemed to adjust the hand as if to make a tactual contact with the edge of the distant rattle. Usually the hand would then come in contact with the other hand for a tactual clasp.[1] Once the child had reached the stage where the hands were joined in the tactual clasp, it was seldom that the adjustment to the edge of the distant rattle would be made unless the experimenter first separated the infant's hands from each other.

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[1] For an interpretation of this separation of the "visual world" and "kinesthetic world" of the child see Piaget (24, pp. 117 ff.).

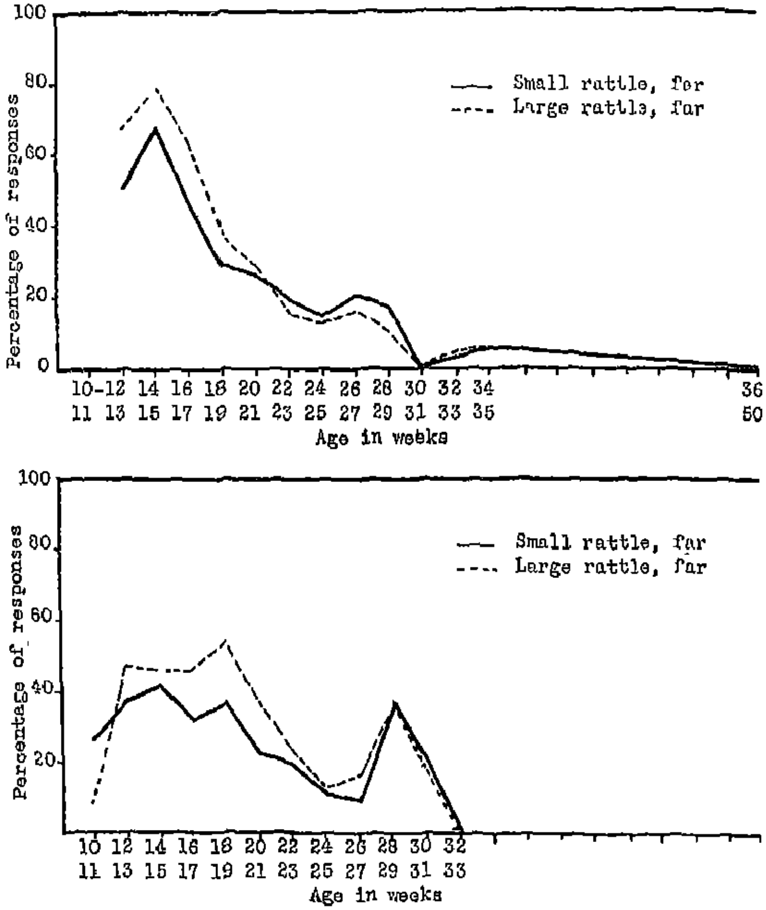

FIGURE 2

RESPONSES TO SITUATION *B* AND SITUATION *C* IN TERMS OF PERCENTAGE OF RESPONSE TO SITUATION *A*

2. *Other Techniques for Studying Constancy Development*

It is clear from what has been said that additional direct evidence for the establishment of size constancy would be highly desirable. Is there, or can there be established, an identical reaction to a given body at different distances, whereas a body of the same projective size as a nearer small body would not elicit the reaction in question? In the former experiment, it might be expected that if the reaction to distance is coupled with a definite perceptual size constancy, the baby would react to the small rattle at a distance with a kind of response which could also be found in the case of Situation *A* Such responses were sometimes found with the older children, but the conditions of the observations were so arranged that they did not favor the maintenance of such responses since the child did not receive the rattle if it did reach for it

Additional experiments introducing "reward" were carried out to see whether the children over six months of age could attain any degree of positive constancy achievement, that is, treat Situations *A* and *B* equivalently as opposed to Situation *C* In this series of trials, the child was given the small rattle if it moved the hand or arm towards the rattle at the near or far position. It was never given the larger rattle. Training periods in this situation were given the child in groups of 10 trials daily Only four children of the ages between six and nine months were studied for any period of time. The indefinite length of stay of any one child in the institution made a study involving learning over a period of time a less profitable one from the experimenter's point of view Hence an attempt was

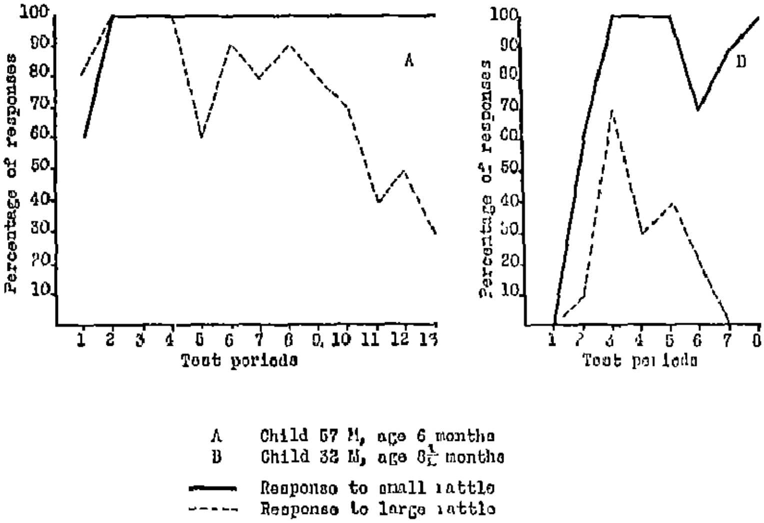

FIGURE 3

INDIVIDUAL LEARNING CURVES FOR TWO INFANTS IN REACHING FOR A LARGE AND A SMALL RATTLE AT A DISTANCE

The child was given the small rattle but not the large rattle made only to show that the child is able to learn to make such a response rather than to make a comparative study Child 57*M*, aged six months, never completely learned the problem before the end of his stay at the institution, but the curve in Figure 3 shows progress towards the "correct" responses. Child 32*M*, aged eight and one-half months, learned to make the "correct" responses and to make no movement when presented with the large rattle This latter child's record is particularly interesting because it indicates an initial lack of movement towards either of the distant rattles, a type of behavior typical of the older child After several trials the child began to approach both rattles, but after six days of trials he no longer moved his hand towards the large rattle

One other attempt to measure any variation in the responses made to the rattles in the three situations used the method of observation and quantification of Fajans (11) The number of seconds which the child spent actively approaching or not looking at the objects was recorded for a period of three minutes Too few records were made for any conclusive results, but the general trend of the results lies in the same direction as that of the other measures of responses Between the ages of two months and three months there is an increase in the time spent in active approach over that spent in passive regard or no regard At four months of age the child approaches the rattle in Situation *C* more actively than it approaches the rattle in Situation *B* The difference between the time spent actively approaching Rattle *C* over that for Rattle *B* is not large but does follow the pattern indicated by the previous observations After five months the child spends less time in actively approaching the rattles in all three situations than it had previously This downward trend is probably to be explained on the basis that the child was not given the rattle to grasp and spent relatively less time attempting to gain the "unobtainable"

3 *Analysis of the Behavior of the Infants in the Three Situations*

A more complete picture of the behavior of the young infant towards the objects in the three positions can be obtained by an analysis of the infant's responses The typical behavior for the various age groups and the percentage of trials of the total trials given for which the behavior item in question was observed can be found in Table 3 Only the protocols of Series II were included in this analysis

a Regard of the object. Nearly all of the situations for all of

TABLE 3

THE PERCENTAGE OF RESPONSES FOR VARIOUS BEHAVIOR ITEMS RECORDED DURING THE PRESENTATION OF THE RATTLES IN THE THREE SITUATIONS (SERIES II ONLY)

	Age in weeks																				
	10-11			12-13			14-15			16-17			18-19			20-21			22-23		
	Situation																				
Behavior item	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*
Regard, immediate	100	95	95	86	82	89	92	64	66	96	96	96	99	95	98	100	100	100	100	100	100
Regard, momentary	0	9	9	10	9	10	4	9	10	0	4	8	1	1	1	*	*	*	*	*	*
No regard	0	0	0	5	6	3	0	7	7	0	5	3	0	1	1	0	0	0	0	0	0
Shifts regard to surroundings	0	5	5	4	3	5	6	10	9	0	1	1	1	2	4	*	*	*	*	*	*
Shifts to hands	0	5	0	10	7	6	4	3	5	9	3	1	10	4	5	5	3	0	6	1	6
Approaches	52	5	5	38	15	15	42	13	13	43	17	23	55	15	26	87	27	40	93	16	23
Arms increase activity	33	66	52	9	13	17	19	28	26	18	20	20	11	25	21	2	13	17	0	4	3
Approach—one arm	19	0	0	2	0	2	9	1	4	18	5	8	21	6	8	34	3	5	34	1	2
Approach—two arms	33	5	5	56	15	13	33	12	9	25	12	15	34	9	18	53	24	37	59	15	21
Hands balled	81	86	86	39	37	38	29	23	23	20	20	20	17	14	12	12	8	8	11	0	0
Hands open	0	5	0	25	20	19	46	44	44	41	36	33	45	46	46	76	77	77	91	91	91
Fingers clasp	9	9	0	20	15	16	10	8	8	10	10	17	21	21	17	6	5	4	5	5	6
Hands together	14	0	0	10	5	7	17	8	8	8	7	9	6	3	2	13	8	12	0	0	0
Hands on cover	9	0	5	18	20	20	8	8	9	22	21	20	1	9	8	1	5	6	1	0	0
Hands to mouth	24	0	5	9	6	4	4	1	2	1	1	1	9	5	5	3	3	0	0	0	1
Grasps—tactile	0			17			11			22			31			37			14		
Grasps	0			0			11			18			51			53			80		
Touches rattle	19			19			12			7			4			0			0		
Head and neck movements	5	14	5	3	7	9	5	9	9	7	6	7	0	7	7	8	18	17	5	5	10
Vocalizations	0	0	0	14	8	10	6	1	4	6	4	1	1	1	2	0	0	0	0	0	1
Smiles at object	0	0	0	13	3	3	5	0	1	1	1	1	3	2	0	0	0	0	0	0	1

	Age in weeks		
	24-25		
	Situation		
Behavior item	*A*	*B*	*C*
Regard, immediate	100	100	100
Regard, momentary	*	*	*
No regard	0	0	0
Shifts regard to surroundings	*	*	*
Shifts to hands	1	0	0
Approaches	98	13	15
Arms increase activity	0	0	0
Approach—one arm	37	8	8
Approach—two arms	61	5	7
Hands balled	9	9	9
Hands open	90	90	90
Fingers clasp	0	0	0
Hands together	0	0	0
Hands on cover	0	0	0
Hands to mouth	0	0	0
Grasps—tactile	3		
Grasps	97		
Touches rattle	0		
Head and neck movements	0	3	7
Vocalizations	0	0	0
Smiles at object	0	1	3

*No adequate measurement made

the age groups gave a high degree of immediate regard of the object. These percentages are much higher than those cited by Gesell and Thompson for the dangling ring situation (14) and are probably accountable on the basis of the size of the objects, the movement and position of the objects, and the fact that *E* was not observable by the child In Series I where *E* was sometimes observed by the child, immediate regard might be upon *E* rather than upon the object Only a small percentage of cases ever completely disregarded the rattles in any position Momentary regard was low for the early ages, and most of the 30 seconds was spent regarding the object After the 18-19-week period, adequate measurement of this category was not made Many of the older children exhibited variable regard of the rattles which were beginning to be recognized as unobtainable

Observation of shifting of regard was never as detailed as that of the arm activity, and unless the infant's regard remained rather consistently away from the rattle, brief variations in this behavior such as cinematographic records alone could best record, were not always observed During the 10-11-week period, there was rather fixed staring with very little shifting of regard. During the 12-13-week period, this staring was still present, but there was an increase in the regard of the rattles, the surroundings, and, in particular, of the hands in their movements The percentages for this latter activity were uniformly low for all three situations for all age groups, but the response was one which when it did occur seemed very important in the general visual motor adjustments for distance. It is quite probable that the low percentage of times in which the shifting of regard to the hand was recorded is due to the fact that shift of regard to the hands was recorded only in those cases where the hands were outside of the visual range and the child turned to look or when the hands moved out of the range of vision and the child turned to follow their movement However, in the middle age groups the hands were probably observed by the child with no apparent shift of regard Gesell and Thompson (14, p 101) report a high percentage shift of regard to the experimenter and the experimenter's hands for the 12-16-week period and relatively low percentages of shift of regard to own hand for the 12-16-week period.

b. Approach movements. The number of approach movements at the first age level studied is extremely high for the near situation.[5] It is possible that a number of spontaneous sporadic movements which occur with visual stimulation and are part of the general picture of "excitement" have been classified as approach movements in the present work. However, in many cases these movements result in contact with the rattle in the near position. This difficulty in distinguishing approach movements from merely increasing activity of the arms is a difficulty noted by Gesell and Thompson for the age periods below 16 weeks (14, p. 104 and p. 113). During the early age periods there were occasionally observed rather sudden "flying" movements of the arm and hand up into the air. In such a movement the hand might chance to come in contact with the rattle in the near position. Later there occurred repeated waving movements of the arms in the air with a beginning adjustment to the position of the object, but this adjustment often resulted in movement of the hands out of the visual field. These movements might be extremely jerky movements. With the use of the eyes in following the movement of the hand, a relatively closer adjustment to the object was obtained. This was followed by the definite movement of the two arms to a center closure on the object if the object were in the near position, but it also occurred with a somewhat lesser frequency for the distant objects. After a period where there was initial dominance of one arm in the reach or an alternate movement of the two arms, the object was reached for with a definite unilateral reach (beyond 26 weeks). While this sequence holds at the earlier steps for all three positions, occurring with a greater frequency for the near position, the sequence varies for the distant object after a fairly adequate reaching response for the near object has been attained. In general, the distant object is not treated as touchable, that is, the hand is not brought around to the frontal position to adjust for a tactual contact with the rattle. The response might be a waving movement at the side wherein there may still be some attempt to reach the distant larger rattle with the hands correctly adjusted to make contact with the outer edge of the rattle. There would be no evidence, however, that there is an overlap of the visual images of the small rattle and hands if the hands are kept waving far apart at the side. Other responses to the distant rattles were taut extension of both arms low at the side, an attempt to reach the object with the foot or feet, or an attempt to change position by coming to the sitting position Quite often the child merely inspects the situation, not moving the arms until the object is brought near enough to grasp If the object is brought towards the baby, the arms seldom adjust to a central position to take the rattle until the rattle is within 10 to 20 centimeters from the fingers Thus while the baby may hold out its arms for distant objects, this response cannot be considered as a reach identical to that of the carefully adjusted preparation for actual contact with the rattle

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[5] Approach movements, as classified here, is a more restricted category than the *similar responses* described in Section E 1.

c. Position of hands and fingers. The position of the fingers seems to have had relatively the same frequency of occurrence in most of the three situations The increase in the hand manipulations, particularly in "tactual clasp," the light contact movements of the hands against the clothes or covers, and the movement of the hands together were three types of hand and finger movements which seemed to prevent the more rapid development of true reaching and grasping. These hand manipulations occurred at their peak at four months and just later and lasted for a period of one to two weeks For individual cases, it was also just before this period and oftentimes shortly afterwards that the greatest frequency of watching the hands occurred In a number of cases it was observed that if the hands were clasped together, there might be merely visual fixation of the object, but if the experimenter unclasped the hands, approach movements would be made

d Grasping The present observations were only incidentally concerned with the problem of grasping and the only records taken were whether in the practice situation the hand grasped the rattle after a contact made either by the experimenter or more or less accidentally by the infant, or whether there was a prepared grasp on the part of the infant The general trend of the grasping response agrees fairly well with the results obtained by other investigators, although in comparing the present figures with those which Gesell and Thompson give for the dangling ring situation and the rattle situation, the percentage of responses is not as high at the various levels as in the dangling ring situation, nor as low as in the rattle situation (14, p 101, and 110).

e Head movements The presence of head movements is interesting as part of the total behavioral pattern of approach In the early ages, the movements seemed to be more of an aid in fixating the object, being mainly lateral head movements. In the later age groups, the head was raised as if to approach the object.

f. *Vocalization and smiling.* Very little vocalization or smiling behavior was recorded for the three situations, although both of these responses were looked for in the observations. The lack of vocalization at this age period has been accounted for by Shirley (29) as apparently occurring when the child is actively concerned with dominant motor adjustment.

F. DISCUSSION

The results of the present experiment show that infants of six months and over succeed in a fairly adequate way in distinguishing stimuli originated by bodies of different size, but equal in the actual gross retinal extension. There were, of course, a number of differences in the stimulus representation. For example, there were, no doubt, differences in retinal disparity, convergence of the eyes, accommodation of the lens, speed of movement of the large and small rattles, besides differences in other aspects of the total situation. No body size constancy whatsoever could be established in perception without the cooperation of some stimulus cues indicating the distance pattern involved. The present investigation as a first attempt to throw light upon the problem of the possibility of a "thing-constancy" in early infancy was limited, therefore, to one particular problem situation in which a fairly well-circumscribed, sufficiently rich number of natural distance cues were present. It is not known from the present observations, however, *how* the child's performance is mediated or which of the available cues are actually used in establishing the differential response. This is a question which should be the topic of further more detailed investigations in which all the possible cues should be adequately controlled and systematically varied.

Since the present observations were limited to a gross ascertainment of the constancy achievement in a certain particular situation, the results should not be interpreted as possessing a high degree of generality. It can, however, be concluded that the possibility of an establishment of an approach towards perceptual "thing-constancy" is present in children of one-half year of age. It is interesting to note in this connection that the results of the work of Rubinow and Frankl (27) in regard to the perception of an object, in particular, the recognition of the bottle in its specific bodily characteristics give evidence that this response first appears at approximately the same time as this trend towards size-constancy. The basic character of the constancy mechanisms in building up our world of steady, stable things would appear the clearer through this coincidence in early developmental stages

It must not be forgotten that the situation used in the present investigation did not measure perceptual size constancy in its strict and positive sense. In the reactions of infants of lower ages where the highest degree of similarity of response was obtained, there was a tendency to react similarly to the rattles of similar retinal sizes. The performance measured in the present investigation is not the performance complete size constancy would necessitate, namely, reacting similarly to objects of constant physical sizes at varying distances Even in the situation in which the child reacts positively to the small rattle at a distance, the possibility of a complete size constancy was not demonstrated Only some technique which would show that there is discrimination of the object identical in physical size from one slightly smaller or larger than the standard would answer this question The age periods beyond five and six months would seem from the results of the present experiment to be most crucial for demonstrating this. It may well be that the tests for size constancy of the later first and early second year will show development of a greater rate than that for the period tested by Beyrl.

In the present study a causal-genetic analysis has been neglected. The observations were made with no attempt to control "training" and "non-training" periods In view of the results obtained by Dennis (10) when infants, raised under as little stimulation as possible, made visual reaching responses at approximately 38 weeks of age whereas the age range of such responses is usually from 12 to 24 weeks, empirical curves worked out for the reaching response in such a situation as the present investigation has set up would be interesting in adding further light upon the development of constancy If such curves were obtained, we would have much more adequate information upon which to base an analysis of the relative influence of maturation and learning as Carmichael (7) suggests.

G. SUMMARY

1. A study was made of the genetic development of visual size constancy in early infancy. The problem was to determine the

development of discriminatory responses to physical bodies of different size which were at varying distances from the eye but which were equal in their gross retinal extension.

2. Seventy-three infants between the ages of 10 and 50 weeks were examined in a total of 521 daily observations. The infants were presented an object (rattle) at a distance of 25 centimeters from the eye (Situation *A*), the same object as in Situation *A* at a distance three times as great (Situation *B*), and an object of the same form and color pattern but three times as large at the same distance as in Situation *B* (Situation *C*). Protocolled records of the infants' responses were made.

3. For the small rattle in the near situation, there was always a greater percentage of responses than for the rattles in the two distant positions. Until the periods of 16-18 weeks, the frequency of responses to the two distant positions increased as well as the frequency of responses to the near position. The larger rattle was responded to with a slightly greater frequency of occurrence than the small rattle at a distance until 22 weeks of age (approximately five months). Around four to five months there is evidence of some confusion between the rattles which are equal in gross retinal extension, but the responses to the large rattle-far situation are never completely equal to the small rattle-near situation as would be the case if projective size were the dominant factor.

4. By six months of age there is evidence that the situations are fairly well differentiated, and the equality of the gross projective sizes of the several situations does not lead to identical response to them.

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The Journal of Genetic Psychology, 1941, 58, 353-362

THE RELATIONSHIP BETWEEN CHILDREN'S TESTED INTELLIGENCE AND THEIR HOBBY PARTICIPATIONS*

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The present analysis is made from data taken from the *Coordinated Studies in Education*, a study made under the general supervision of an advisory committee composed of Dr. H. A. Greene of the University of Iowa, Dr. Le Roy A. King of the University of Pennsylvania, Dr. J. C. McElhannon of Baylor University, Dr. I. R. Obenchain of the Birmingham City Schools, Dr. Henry J. Otto of the W. K. Kellogg Foundation, Dr. David Segal of the United States Office of Education, Dr. M. J. Van Wagenen of the University of Minnesota, and the writer, who served as chairman.

In the instance of the present consideration sixth grade children alone are involved. Of a total of 4,779 cases, 2,342 are boys and 2,437 are girls. They were drawn from 258 schools located in 31 states, a rather large proportion of which are in the north-central and north-western sections of the United States, although all regions are represented.

Several different types of records were obtained on each child. Among these were intelligence quotient data as derived from the Kuhlmann-Anderson *Tests*, and a statement of the hobby or hobbies in which each child engaged. This latter record was prepared by the teacher after conference with the child. A child could be listed as having several specified hobbies, or as having only one particular hobby, or as not having a hobby. In order to systematize reports the following check list of hobbies was presented for the teacher's use.

Hobbies

1. Reading—novels, mysteries, fanciful stories
2. Reading—history, science, biography, etc.
3. Reading—funny papers, comics
4. Active games or sports—football, tennis, riding, hiking, etc.
5. Quiet games—checkers, old maid, jacks, solitaire, etc.

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*Received in the Editorial Office on January 18, 1940.

6 Playing musical instruments—not radio or phonograph
7 Listening to radio, or phonograph
8 Sewing, knitting, fancy work, etc
9 Housework—Cooking, sweeping, straightening, etc
10 Going to shows
11. Dramatics—participating
12. Playing make-believe games—teacher, mama and papa, store, church, etc
13 Religious activity
14 Building things, or shop work
15 Traveling
16 Driving car, riding in airplane
17 Studying
18 Working—farm, store, etc
19 Clubs—social, dancing, etc
20 Scouting, or other serious forms of club activity
21 Collecting
22 None.

Data from the original record sheets were transferred to Hollerith cards, and the following analyses and distributions were developed from Hollerith sortings The intelligence quotient distributions were prepared for all children listed as having a given hobby Naturally a child's *IQ* record may appear in two or more distributions, exclusive of the non-hobby distribution, because most children had from three to six recorded hobbies

In Table 1 will be found a summary of the test data arranged by sexes and hobbies. The number of cases in each hobby group also are presented

As one reviews this table one of the most clearly evident conditions is that of pronounced sex differences As a matter of fact, the girls' *IQ* median is higher than the boys' for each of the 22 hobby groups This consistency of girls' superiority may be due to an actual superiority of girls such as are included in this study On the other hand, the female superiority may be a function of the test, and as such not significant with respect to the true basic aptitudes of the two sexes In any event, it is worthy of note that at most points of comparison the obtained differences between the sexes are not sufficiently large to be statistically significant This is especially true in the case of the non-hobby, sewing and fancy work, religious activity, housework, and dramatics groups where the critical ratio (taken off of probable errors) in each instance is less than 2 50

TABLE I

SUMMARY OF *IQ* DATA FOR CHILDREN OF EACH SEX WHO HAVE DESIGNATED HOBBIES

	Boys				Girls			
Hobby	*Med*	*Q*	*PI* $_{md}$	*N*	*Med*	*Q*	*PI* $_{md}$	*N*
1	101.77	8.83	41	785	104.99	8.27	34	998
2	104.19	8.87	56	420	106.27	8.32	55	374
3	100.69	9.14	36	1075	103.71	8.78	34	1103
4	99.71	9.16	31	1502	103.87	8.57	33	1077
5	100.97	8.79	50	490	102.95	8.44	44	607
6	102.91	8.51	58	345	106.74	7.69	41	510
7	100.18	8.95	42	739	103.73	8.71	39	820
8	101.74	8.95	1.28	78	103.45	8.67	37	912
9	100.26	8.66	81	181	102.32	8.50	37	836
10	99.49	9.72	46	779	103.45	8.69	10	764
11	103.44	9.67	98	149	106.44	9.92	77	272
12	101.44	8.15	78	181	105.15	8.56	49	509
13	102.30	8.54	77	194	104.11	8.66	54	421
14	101.42	9.10	43	755	105.00	7.71	1.02	90
15	103.33	8.97	77	215	106.32	7.67	66	222
16	96.40	9.10	89	165	108.00	8.51	1.29	71
17	101.43	9.70	1.02	146	105.06	8.28	69	238
18	98.13	10.38	73	318	104.67	8.56	91	142
19	98.27	7.40	92	69	106.78	7.54	75	166
20	101.12	8.38	65	277	107.07	7.30	58	251
21	104.65	9.32	54	467	107.03	8.51	55	386
22	97.00	10.33	1.04	122	97.91	9.69	1.25	110

In still other terms, it would appear that the girl with one of these hobbies is likely to be a little lower in tested intelligence, as compared with other girls in her group, than is the boy with such a hobby when compared with the other boys This tendency appears to be especially pronounced in the case of non-hobby girls where the critical ratio of the differences is only .56 This forms an interesting contrast with the critical ratio of 11 37 for the difference between the medians of the total group of boys and total group of girls.

Just as surely as girls selecting certain hobbies tend to be lower in their group of girls than are boys who select these same hobbies, there are other hobby groups in which girls of relatively higher tested intelligence tend to participate more than in the case with boys Thus, there is a mathematically significant difference, in favor of girls, between the *IQ* medians of boys and girls who read novels, funny papers, take part in active sports, play musical instruments, listen to the radio, go to the show, play make-believe games, drive a car, work, participate in social clubs, and do scouting In these instances it appears that the average boy who engages in one of the hobbies tends to be lower in tested intelligence when compared with the other boys, than is the girl participant when compared with other girls

Another rather evident though related fact with respect to Table 1 is that there is considerable variation in hobby participations and *IQ* scores for the two sex groups Thus, whereas the car driving group of girls has the highest median *IQ*, the same group of boys has the lowest median *IQ*[1] This lack of concomitant *IQ* variation from one hobby group to another is seen in the low correlation of 36 between the medians for the two sexes. If one eliminates from consideration the non-hobby group of each sex this correlation is reduced still further In fact, it becomes only 13 which, of course, means that the association between hobby participation and intelligence among boys is on an almost completely different basis from the association of these two variables among girls

When one turns to an analysis of the intelligence test score most characteristic of children possessing each hobby, a study of Table 2 will reveal that children who possess certain hobbies tend to be of about average intelligence whereas those with other hobbies tend to deviate rather markedly. Thus, among boys, it will be noted that the average boy with either a fancy work, or a study hobby is neither significantly superior nor inferior in tested intelligence to the average boy in any other hobby groups In other terms, in light of the sample population herein considered there is no reasonable basis for anticipating significant acceleration or retardation in tested intelligence on the part of a boy with either one of these hobbies Except when compared with the non-hobby group, the same statement can be made with respect to girls who have either shop work or study as their hobby Incidentally, it probably is of more than passing interest to note that both among boys and girls the child with a primary study interest is not found to be exceptionally bright, on the average To the contrary this hobby interest appears as an attribute of mediocrity about as frequently as a characteristic either of superiority or inferiority. This statement is substantiated still further by an analysis of Table 4

Table 3 is compiled from Table 2 In Table 3 one finds a sum-

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[1] In this particular instance it probably is worthy of note that only 71 girls as opposed to 165 boys have this hobby

TABLE 2

Critical Ratios of Differences between Median *IQ* s for Children Having Specified Hobbies
Boys' Data in Lower Left, and Girls' Data in Upper Right Portions of Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1		+1 98	—2 65	—2 36	—3 66	+3 14	—2 43	—3 06	—5 31	—2 95	+1 72	+27	—6 31	+01	+1 79	+2 26	+09	—33	+2 14	+3 09	+3 15	—5 46
2	—3 49		—3 95	—3 74	—4 71	+67	—3 77	—4 25	—5 96	—4 14	+18	—1 52	—2 83	—1 09	+06	+1 25	—1 37	—1 51	+66	+1 00	+98	—6 12
3	+2 00	+5 27		+34	—1 36	+5 43	+04	—52	—2 76	—49	+3 24	+2 41	+63	+1 19	+3 51	+3 19	+1 75	+99	+3 68	+4 98	+5 13	—4 48
4	+4 01	+6 79	+2 04		—1 67	+5 22	—27	—85	—3 12	—81	+3 07	+2 17	+3 84	+1 05	+3 52	+3 14	+1 56	+83	+3 56	+4 79	+5 93	—4 61
5	—1 24	+4 28	—47	—2 14		+6 10	+1 33	+87	—1 10	+84	+3 94	+3 34	+1 68	+1 85	+4 25	+3 71	+2 59	+1 70	+4 30	+5 64	+5 79	—3 81
6	+1 61	+1 59	—3 27	—4 87	—2 53		—5 12	—5 72	—7 58	—5 53	—34	—2 42	—3 81	—1 57	—53	+92	—2 06	—03	+05	+45	+41	—6 66
7	+2 71	+5 73	+90	—90	+1 19	+5 81		—52	—2 62	—50	+3 14	+2 27	+58	+1 16	+3 38	+3 17	+1 68	+95	+3 61	+4 78	+4 89	—4 44
8	+02	+1 75	—80	—1 54	—56	+83	—1 16		—2 16	90	+3 51	+2 77	+1 02	+1 47	+3 79	+3 39	+2 06	+1 24	+3 98	+5 26	+5 27	—4 26
9	+1 62	+3 89	+47	—63	+77	+2 66	—09	+98		+2 07	+4 82	+4 60	+2 77	+2 54	+5 28	+4 25	+3 50	+2 40	+5 33	+6 91	+7 08	—3 39
10	+3 70	+6 02	+2 04	+40	+2 17	+4 63	+1 11	+1 65	+83		+3 45	+2 69	+99	+1 48	+3 72	+3 36	+2 02	+1 23	+3 92	+5 13	+5 26	—4 22
11	—1 57	+66	—2 64	—3 63	—2 24	—46	—3 06	—1 05	—2 50	—3 65		—1 41	—2 49	—1 13	—12	+1 04	—1 33	—1 49	+22	+65	+62	—5 81
2	+.38	+2.87	—89	—2 06	—51	+1 51	—1 42	+20	—1 05	+2 05	+1 60		—1 44	—13	+1 42	+2 06	—11	—46	+1 82	+2 55	+2 55	—6 14

TABLE 2 (*continued*)

	—	+	—	—	—	+	—	—	—	—	+	—		+	+	+	+	+	+	+	+	—
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
13	65	1 97	1 91	3 12	1 45	63	2 42	38	1 82	3 14	91	.78		77	2 61	2 39	1 09	53	2 91	3 73	3 82	4 57
	+	+	—	—	—	+	—	+	—	—	+	+	+		+	+	+	—	+	+	+	—
14	59	3 91	1 32	3 23	68	2 06	2 06	24	1 27	3 07	1 89	02	1 01		1 09	1 82	05	24	1 40	1 76	1 75	4 39
	—	+	—	—	—	—	—	—	—	—	+	—	—	—		+	—	—	+	+	+	—
15	1 79	90	3 12	4 37	2 57	43	3 59	1 07	2 74	4 29	09	1 72	95	2 17		1 16	1.32	1 47	46	85	83	5 95
	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		—	—	—	—	—	—
16	5 48	7 41	4 46	3 51	4 47	6 14	3 84	3 42	3 21	3 09	5 29	4 25	5 02	5 07	5 89		6 35	6 68	2 58	66	69	5 57
	+	+	—	—	—	+	—	+	—	—	+	+	+	—	+	—		—	+	+	+	—
17	31	2 37	69	1 61	40	1 26	1 13	19	90	1 73	1 42	01	68	01	1 49	3 71		3 41	1 69	2 23	2 23	5 04
	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	+		+	+	+	—
18	4 34	6 59	3 13	1 99	3 10	5 12	2 44	2 45	1 95	1 58	4 35	3 09	3 93	3.89	4 90	1 50	2 63		1 79	2 22	2 03	5 73
	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	+	—		+	+	—
19	3 47	5 50	2 44	1 48	2 48	4 26	1 89	2 20	1 63	1 19	3 84	2 63	3 36	3 11	4 22	1 46	2 30	12		31	27	6 08
	+	+	—	—	—	+	—	+	—	—	+	+	+	+	+	—	+	—	—		—	—
20	84	3 58	59	1 96	18	2 06	1 22	43	83	2 05	1 97	32	1 17	39	2 19	4 28	26	3 06	2 53		05	6 65
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—
21	4 25	59	6 10	7 93	4 99	2 20	6 53	2 10	4 51	7 91	1 08	3 38	2 50	4 68	1 40	7 92	2 79	7 18	5 99	4 18		6 66
	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	+	+	+	+	+	
22	4 26	6 08	3 34	2 50	3 44	4 97	2 55	2 87	2 47	2 19	4 51	3 42	4 09	3 92	4 89	44	3 04	68	91	3 35	6 52	

*A + indicates that the median *IQ* of the hobby group whose number appears at the *top of the column* is greater than the median *IQ* of the hobby group whose number appears at the *left of the row* A — indicates the reverse Thus, among boys, the median *IQ* of hobby group No 1 is less than the median *IQ* of hobby group No 2, and the critical ratio of the difference is 3 49 Similarly, among girls, the median *IQ* of hobby group No 2 is more than the median *IQ* of hobby group No 1, and the critical ratio of the difference in 1 98

TABLE 3

Summary, for Each Sex, Compiled from Table 2, Showing All Instances of Significant Differences (*i e*, *CR*=3 85) between Median *IQ*'s of Children in Various Hobby Groups*

Boys			Girls		
Hobby	Surpasses	Is surpassed by	Hobby	Surpasses	Is surpassed by
1	4, 16, 18, 22	21	1	9, 13, 22	
2	3, 4, 5, 7, 9, 10, 14, 16, 18, 19, 22		2	3, 5, 8, 9, 10, 22	
3	16	2, 21	3	22	2, 6, 20 21
4		1, 2, 6, 15, 21	4	22	6, 20, 21
5	16	2, 21	5		2, 6, 11, 15, 19, 20, 21
6	4, 10, 16, 18, 19, 22		6	3, 4, 5, 7, 8, 9, 10, 22	
7		2, 21	7	22	6, 20, 21
8			8	22	2, 6, 19, 20, 21
9		2, 21	9		1, 2, 6, 11, 12, 15, 16, 19, 20, 21
10		2, 6, 15, 21	10	22	2, 6, 19, 20, 21
11	16, 18, 22		11	5, 9, 22	
12	16		12	9, 22	
13	16, 18, 22		13	22	1
14	16, 18, 22	2, 21	14	22	
15	4, 10, 16, 18, 19, 22		15	5, 9, 22	
16		1, 2, 3, 5, 6, 11, 12, 13, 14, 15, 20, 21	16	9, 17, 18, 22	
17			17	22	16
18		1, 2, 6, 11, 13, 14, 15, 21	18	22	16
19		2, 6, 15, 21	19	5, 8, 9, 10, 22	
20	16	21	20	3, 4, 5, 7, 8, 9, 10, 22	
21	1, 3, 4, 5, 7, 9, 10, 14, 16, 18, 19, 20, 22	1, 2, 6, 11, 13, 14, 15, 21	21	3, 4, 5, 7, 8, 9, 10, 22	
					1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21

*In order to read this table look at Hobby 1 for boys Here we find that the median *IQ* for boys with this hobby is significantly higher than the median *IQ* of boys who participate in Hobbies 4, 16, 18, and 22, but, in turn, is significantly lower than the median *IQ* of boys with Hobby 21 mary of the relative superiority and inferiority, to the extent of mathematical significance,[2] in intelligence of those in each hobby group as compared with those in all other hobby groups Thus, it can be noted that boys with hobby No 1, reading novels, mysteries, and the like, tend to be significantly superior in tested intelligence, on the average, to boys whose hobbies are either active games or sports, or driving a car, or working, or to boys who have no hobby On the other hand, these novel reading boys, on the average, tend to be significantly lower in tested intelligence than boys in the collecting hobby group Girls with this reading hobby, however, tend to be significantly superior, on the average, to girls in the housework, religious activity, and non-hobby groups, and are not surpassed to a significant extent by those having any other hobby

A continued analysis of Tables 2 and 3 reveals the fact that among boys the hobbies whose participants are most frequently significantly superior in tested intelligence to those in other hobby groups are: first, collecting, which surpasses any other group; second, reading history, science, biography, and so forth, the members of which group, on the average, surpass 11 other hobby groups, third, and fourth, playing musical instruments, and traveling, fifth, reading novels; and sixth and seventh, participating in dramatics, and religious activity Among girls, the hobbies most likely to be associated significantly with intelligence superiority are: first, second, and third, playing musical instruments, and collecting, and scouting or other forms of serious club activity; fourth, reading history, science, biography, and the like, fifth, social clubs, dancing, and so forth; sixth, driving a car

Rather interestingly, among girls no one hobby dominates the field as completely as does collecting among boys. At the same time, the average *IQ* of girls without a hobby is surpassed by the averages of 19 other hobby groups, and this pronounced inferiority in median intelligence is not found for any of the boys' groups Among boys, the car driving group is surpassed significantly in median *IQ* by 12 other hobby groups Practically the same condition is met among girls who indicated a housework hobby Their *IQ* average is significantly lower than that of 10 other groups and significantly superior to none

In Table 4 a still different approach is seen to the problem In

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[2] This is taken to be indicated by a *CR* of 3 85 or above

TABLE 4

PER CENT OF CHILDREN, EACH SEX, IN BOTH HIGH AND LOW INTELLIGENCE GROUPS WHO PARTICIPATE IN DESIGNATED HOBBIES, TOGETHER WITH GROUP DIFFERENCES AND CRITICAL RATIOS

	Boys				Girls			
	High *IQ*	Low *IQ*	*Diff*	*CR*	High *IQ*	Low *IQ*	*Diff*	*CR*
1	47	26	21	10.01	46	31	15	7.06
2	31	10	21	8.53	19	09	10	6.80
3	51	42	09	4.09	46	43	03	1.36
4	69	65	04	1.91	47	41	06	2.73
5	25	19	06	3.24	24	28	—04	2.03
6	21	11	10	1.21	30	12	18	10.55
7	33	31	02	.96	35	34	01	.47
8	06	02	04	4.39	38	39	—01	.47
9	08	08	—	—	32	38	—06	2.81
10	33	37	—04	1.89	31	32	—01	.48
11	10	05	05	4.14	15	06	09	6.92
12	09	07	02	1.63	26	17	09	5.01
13	16	12	04	2.56	19	17	02	1.18
14	39	29	10	4.76	04	04	—	—
15	14	07	07	5.02	12	06	06	4.86
16	06	08	—02	1.77	05	03	02	2.27
17	08	06	02	1.73	11	09	02	1.52
18	13	17	—04	2.53	07	05	02	1.89
19	03	02	01	1.40	10	07	03	2.42
20	12	10	02	1.42	16	06	10	7.58
21	34	11	23	12.64	24	10	14	8.82
22	02	05	—03	3.47	03	09	—06	5.35

this instance children whose intelligence quotients are 110 or above are segregated and their hobby participations analyzed, whereas the same procedure is carried out for those whose intelligence quotients are under 90. When these bright and dull groups, for each sex, are compared one finds some very striking facts. First, of course, it will be noticed that bright children equal or excel dull children in frequency of hobby participations in all but three of the 21 hobby groups of boys, and all but four of the 21 girls' groups. In fact, the average bright boy has 4.87 hobbies compared to 3.63 for the dull boy, and the average bright girl has 4.98 hobbies as compared with 3.94 participated in by the average dull girl.

When one picks out the activities in which the bright boy tends to participate significantly more frequently than the distinctly dull boy, we note: (*a*) collecting, (*b*) reading novels, mysteries, and so forth; (*c*) reading history, science, biography, (*d*) traveling, (*e*) building things or shop work, (*f*) sewing, fancy work, (*g*) dramatics, and (*h*) reading the funny paper In turn, really superior girls participate with significantly greater frequency than inferior girls in (*a*) playing musical instruments; (*b*) collecting, (*c*) scouting and serious club activity, (*d*) reading novels, mysteries, and so forth, (*e*) dramatics; (*f*) reading history, science, biography, (*g*) playing make-believe games, and (*h*) traveling In no instance do inferior boys exceed superior ones to a significant degree, and only in the case of no hobby participations do inferior girls exceed in frequency intellectually superior ones

In light of the data presented in the foregoing analyses the following appear to be valid conclusions from this study:

1. Some hobbies tend to be participated in more frequently by children of high tested intelligence than do other hobbies

2 Pronounced sex differences in the intelligence-hobby relationship exist In fact, one has only a very meagre basis for anticipating the type of intelligence which will be associated with hobby participation in one sex group from a knowledge of the nature of this relationship in the other sex group

3 When both sex groups are considered together the hobbies of collecting, playing musical instruments, and reading history, science, biography, and the like appear most likely to be participated in by those of superior intellectual ability

4. No single hobby appears to be associated consistently with children of lower than average intelligence as are the three hobbies just mentioned associated with those of above average intelligence

5 Very superior children appear to have a greater diversification of hobby interests than very inferior ones

6. Very superior children tend to engage in certain types of hobby activities much more frequently than very inferior ones Furthermore, they do not participate with significantly less frequency in any type of hobby than do very inferior children.

7. The child without a hobby is more likely to be below average in intelligence than is the child with hobbies. This is particularly true with respect to girls

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The Journal of Genetic Psychology, 1941, 58, 363-389

READING INTERESTS OF YOUNG CHILDREN*

Department of Education, Hunter College

Frank T. Wilson[1]

In the late fall of the school year 1938-1939 a questionnaire study of young children's interests was made by the cooperative and helpful interest of the parents of pupils in the kindergarten and first and second grades of the Hunter Model School of Hunter College, New York City. One hundred and fifty-two returns were received out of about 175 inquiries sent to parents. The distribution of the returns by grade levels was kindergarten 37, 1*A*, 35; 1*B*, 31; 2*A*, 18; 2*B*, 31. The intelligence quotients and the social status of the children were above average, as indicated both by the results of standardized mental tests given the children and by the number of parents in professional and upper bracket income groups.

This report will reproduce the questions asked the parents, give the replies in tabular form, and make comments on some of the items.

There were no clear grade trends apparent in the replies of the parents. Mention of possible trends will be made in the comments on various items. There was some indication that the parents of kindergarten children gave fuller and perhaps more exact information than the other parents on questions relating to pre-school matters. The slight differences found may have been due, however, to selective factors other than the recency of the information for the parents of the younger children.

The questionnaire was divided into two parts. The first part referred to reading interests and activities of the children before they entered school. The second part referred to their interests at

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*Received in the Editorial Office on February 5, 1940.

[1] This report was made possible through the cooperative efforts of parents of pupils in the Model School of Hunter College, who answered the questionnaire, students of Hunter College, who assisted with tabulation of results, and a faculty committee composed of Miss Elizabeth Barry, Miss Florence Brennan, and Miss Margaret Rooney, teachers in the Model School, and Mr. Solomon Bluhm, Miss Florence Brumbaugh, and Mr. Frank Wilson, of the staff of the Department of Education, Hunter College. Prepared with the assistance of *W P A* Official Project No. 165-97-6172, Sub 4.

the time the questionnaire was in the hands of the parents. This explains the supposition that the parents of the kindergarten children would be clearer on pre-school matters. The first three questions were simple registration data Preceding Question 4 the following underlined statement was made

Questions 4 to 19 inclusive refer to reading interest or activities of the child before entering the kindergarten or the first grade.

Questions 4 to 7, inclusive, were designed to reveal the extent and nature of home help in learning to read The questions and returns were as follows.

4 (*a*) *Was the child given any reading instruction at home before entering school?*

No	86
Yes	63
No answer	3

(*b*) *If so, at what age was this begun?*

	Grades Kdn	1A	1B	2A	2B	Total
After 1 yr of age	2	0	0	0	0	2
" 2 " " "	3	0	1	0	1	5
" 3 " " "	3	2	1	1	1	8
" 4 " " "	6	4	4	1	5	20
" 5 " " "	3	5	2	1	1	12
" 6 " " "	0	0	0	0	1	1
Totals	17	11	8	3	9	48
No answers (of the 63 *Yes* above)						15
						63

The modal age for every group was 4

(*c*) *For how long was this continued?*

To present time, or until school entrance	30
One-half year to 3 years	11
Short time	4
No answer	3
	48

5 *Was the child's interest fluctuating or sustained for a long period of time?*

Fluctuating	31
Sustained	32
Total	63

6 *What types of instruction were used?*

Number of parents answering	84
Number not answering	68
Total	152

Letter (A, B, C)	60
Story	43
Word	21
Phonetic	18
Sentences	9
Other	1
Total	152

Number of parents checking 1 method only	37	
" " " " 2 methods only	28	56%
" " " " 3 " "	12	
" " " " 4 " "	6	
" " " " 5 " "	1	

7 *What types of material were used?*

Number of parents answering	87
Number of parents not answering	65
Total	152

Letter blocks	60
Picture books	60
Mother Goose rhymes	53
Story books	45
Poems	25
Card games	16
Primers	14
Signs	13
Work books	10
Flash cards	7
Original written material	7
Charts	3
Other	12
	325

Number of parents checking 1 item only	13	
" " " " 2 items only	10	
" " " " 3 " "	19	75%
" " " " 4 " "	16	
" " " " 5 " "	13	
" " " " 6 " "	10	
" " " " 7 " "	4	
" " " " 8 " "	1	
" " " " 12 " "	1	
Total	87	

COMMENTS

To Question 4, 63 or 41 per cent of the parents responded that they had given reading instruction at home before the children entered school Of these, 48 indicated the ages at which they began the instruction Their answers indicated considerable variation in the meanings given to the term "reading instruction." Many parents seemed to have felt that incidental help, such as giving letter names, reading signs, house numbers, etc , was not reading instruction, while others recognized it as such The varying number of parents checking the points under Questions 6 and 7 indicates this confusion. There are many reasons for regarding this incidental learning as definite and important progress in the early stages of reading.[3] If this point of view had been held by all parents the number of *Yes* answers to Question 4 (*a*) might have been considerably larger

The 48 parents answering 4 (*b*) indicated the age of four as the most common age at which they began reading instruction On the supposition that this instruction was the formal sort of reading instruction, it is interesting to compare the ages at which these parents said they began to help their children learn to read with the mental age of 6½ years, which traditionally is accepted by school people as the right mental age for children to learn to read In order to have reached the mental age of 6½ years the four-year old children would have had to average 144 *IQ* The eight three-year olds would have had to average 186 *IQ* As a matter of fact, the children concerned were not nearly so bright. Perhaps the ages mentioned by the parents were a little in error It is possible, too, that the tradition of waiting for a mental age of 6½ years to begin to learn to read is inappropriate for children similar to those studied

Question 5 produced evenly divided answers It was not a good question because the interpretation of the words *fluctuating* and *sustained* was not made, and this undoubtedly varied considerably in the minds of the 63 persons responding

Questions 6 and 7 asked for information on types of instruction and materials used by the parents The most common types of instruction were first the letter and second the story method The other three methods—word, phonetic and sentence methods—were much less frequently mentioned This information is noteworthy in view of the current opposition to the letter method and the methodological insistence, in schools, upon word and sentence methods. Either the parents were not in complete agreement with present methods of teaching beginning reading, or circumstances, including their own childhood training, induced them to make wide use of the letter method. Recent studies have indicated that there is much to be said, among other things, in favor of giving direct and early attention to letters as the basic symbols of reading (1, 2).

Replies to Question 7 showed that letter blocks, picture books, Mother Goose Rhymes, and story books were among the materials most commonly used. Seventy-three per cent of the parents indicated three or more types. Unfortunately alphabet books were not given on the check list. The probabilities, however, are that many of the picture books referred to by the parents were alphabet books.

The answers to Questions 6 and 7 point to the tendency of the parents questioned to use predominantly both letter and story methods as the natural approaches for their children in learning to read. Both time and convenience would favor such methods since letter blocks, Mother Goose Rhymes, picture and story books have long held a favored place in the hearts of both parents and commercially minded dealers in young children's supplies.

Questions 8, 9, 10, 14, 15, and 16 were designed to reveal something of the nature of the early stages in learning to master written language. They were as follows:

8. (*a*) *Did the child show curiosity or try to read by himself?*

Number answering	131
Number not answering	16
Number answering no	5

(*b*) *If so, what types of materials?*

Picture books	88
Signs on street, subways, etc.	80
House numbers	76
Mother Goose Rhymes	73
Story books	63
Funnies, comic strips, magazines, gum wrappers, etc.	57
Labels on packages	56
Telephone numbers	52
Newspaper headlines, advertisements, etc.	45
Magazines	42
Games	33
Readers	25
Puzzles	24
Scrap books	20
Jokes	13
Riddles	5

Dodgers from stores	5
Others	
Only letters of alphabet	1
Lettered blocks	1
Alphabet and few words	1
Anything, most everything	4
Not much	1
	871

Number of parents checking	1 type only	7
	2 types only	7
	3 " "	11
	4 " "	13
	5 " "	12
	6 " "	11
	7 " "	10
	8 " "	13
	9 " "	13
	10 " "	8
	11 " "	7
	12 " "	9
	13 " "	1
	14 " "	2
	18 " "	2
	20 " "	1
	"most everything"	4
	Total	131

9. (*a*) *Was the child able to write or print his name?*

Yes	111
No	22
No answer	19

(*b*) *Could he identify his name when he saw it written or printed?*

Yes	128
No	9
No answer	15

10. (*a*) *Did he recognize any letters of the alphabet?*

Yes	111
No	3
No answer	38

(*b*) *Which ones?*

	Answers indicated by grades					
	Kdn	1A	1B	2A	2B	Total
All	22	17	19	6	11	75
Practically all	4	3	2	1	3	13
Own name	4	3	4	1	1	13
Good many, first half	1	1	2	2	1	7
No answer	2	2	1	2	9	16

A	3	5	2	3	6	19
B	3	3	2	3	5	16
C	2	1	2	2	5	15
D	2	3	2	1	4	12
E	2	3	2	2	4	13
F		3	2		2	7
G		1	1		2	4
H	2	3			2	7
I	1	3			1	5
J		2			1	3
K		2			2	4
L		2			3	5
M	1	2	1		2	6
N	2	4			2	8
O	1	4	2	1	1	9
P	1	2			2	5
Q					1	1
R	1	4	1		1	7
S		2	2		1	5
T	1	3	1		2	7
U		1				1
V		1				1
W		2				2
X	1	1	1	1		4
Y	2	1				3
Z	2	1	1	1		5

14 *Was he interested in writing or printing letters, numbers or words?*

Yes	127
No	8
No answer	17

15 *When did he learn to recite some of the number series, up to 15 or 20?*

Number answers	114
No answer	38

After 2 years of age	7
3	34
4	45
5	19
6	9

16 (*a*) *When did he learn to recite some of the alphabet?*

Number answering	105
No answer	47

After 2 years of age	15
3	37
4	35
5	13
6	5

(*b*) *When all of it?*

Number answering	93
No answer	59

After 2 years of age	4
3	24
4	32
5	27
6	6

COMMENTS

The answers to Question 8 showed a widespread and general interest in reading among these children before they entered school Only five parents answered that their children did not show curiosity or try to read by themselves Only 16 gave no answers One hundred and thirty-one parents indicated a total of 871 interests in the 21 various types of material named on the questionnaire and three others added by parents The four most common types of material were, in order · picture books, 88, signs, 80; house numbers, 76, and Mother Goose Rhymes, 73

The answers to the other five questions in this group showed that a very large majority of the children had made much progress in mastering the basic symbolization of written language, namely, letters and numbers. The beginning of this progress was at a very early age, according to the parents One hundred and twenty-seven were interested in writing or printing letters, numbers, and words Eighty-six were said to be able to recite some of the alphabet before they were five years old, 15 before three, and 60 could say the entire alphabet before five years of age.

Question 10 deserves more careful attention The general interest of young children in learning and using the letters of written language, makes the analysis of their progress in this skill analogous to that of early word mastery For this reason the details of the reported achievements of these children before they entered school are given for each group The differences shown in the four groups are not great and indicate a degree of validity some readers may not have expected The figures show what would logically be supposed, namely, that the first part of the alphabet is the easiest one for children to learn, due, probably in part, to the tendency of parents to give it more attention just because it comes first The hardest ones, as indicated by the number knowing them, were *Q, U, V,* and *W* Perhaps *Q* is less frequently used than any other letter, and the similarity of *U, V,* and *W* may produce confusion that makes their learning harder Also, many words used in alphabet books to teach these letters, are not as familiar, in terms of children's experiences, as words for other letters For example, *Queen* for *Q, Vase* for *V,* etc., are less common in children's lives than *Apple, Boy,* and the like

Questions 11, 12 and 13 also were related to the early reading interests of the children, but from the side of parental relationships.

11. *Did he receive encouragement from his elders to acquire reading skill?*

Little	58
Some	43
Much	16
No	15
Yes	7
No answer	13

12 (*a*) *Were any efforts made by elders to prevent the child from reading at an early age?*

No	118
Yes	10
No answer	24

(*b*) *If so, describe*

Few answers were given.

13 (*a*) *Did the child have any aversion to reading activities or materials?*

No	121
Yes	4
Little	1
No answer	26

(*b*) *If so, describe*

Few answers were given

COMMENTS

The answers to Question 11 showed that only 16 children received "much" encouragement from parents to acquire reading skill. Apparently the large majority of the children were, perhaps by the sheer force of circumstances of living in a reading world, "naturally" interested in learning to read Only 10 parents said they made efforts to prevent their children from reading at an early age, giving such reasons as, "waiting for school instruction," turning child's activities "to use of large muscles," and "on advice of doctor" who believed it "would overtax her mind"

(One wonders what the physician meant, psychologically, if anything?) From Question 13 it appears that only four children had aversions to reading, the explanations being, "seemed to be afraid of reading," "a little," "didn't want to sit still," and "unpleasant or frightening plots."

Questions 17, 18, and 19 were related to children's interests in hearing stories

17. *At what age did the parent or governess begin to tell stories to the child?*

Number answering		131
No answers		21
After age of 2 years	53	89
3	36	
4	10	
5	2	
6	30	
Total	131	

18. *At what age did the parent or governess begin to read to him?*

Number answering		137
No answer		15
After age of 1 year	20	114
2	54	
3	40	
4	18	
5	4	
6	1	
Total	137	

19. *How much reading to him was done?*

Number answering	147	
No answers	5	
One hour or more daily		18
A half hour to an hour daily		37
A quarter to a half hour daily		52
A few minutes daily		27
A few minutes weekly or occasionally		13
Total		147

The replies to these questions imply an early and, judged by the daily time allotted, a persistent interest in hearing stories and the like. Eighty-nine parents reported that their children had been told stories while one, two, and three years of age. Inexact as memory is, the fact seems indisputable that these interests of young children begin very early.

The general conclusion from this first part of the questionnaire seems to be that the 152 children studied were early interested in learning the mechanics of reading and enjoying the activities of reading. In these early stages of reading, attention to the basic symbols of written language—letters, numbers, and words—was conspicuous on the side of learning the mechanics of reading. On the side of interests in the early stages, there were indicated not only traditional children's stories, nursery rhymes, etc., but, very prominently, the materials of the social environment in which the children lived—signs, house, telephone, and automobile numbers, labels, letters and post cards, newspapers and magazines, etc. Apparently the pre-school way of learning to read is by the use of reading materials of everyday life, with direct attention to the basic elements of written language. In this way learning tends to be functional as to both the mechanics and the substance of reading. That is, satisfactions in reading are experienced because of information, enjoyment or some other usefulness of reading efforts, and skill in reading is developed in these same experiences. Presumably, these satisfactions are widely involved as the motives for learning to read.

The second part of the questionnaire was preceded by the following statement:

> *Questions 20 to 37 refer to the reading interests and activities of the child at the present time.*

Questions 20, 21, 22, and 23 dealt with types of reading materials preferred by the children.

20. *What magazines are preferred by the child?*

Number answering 145
No answers . 7

	Kdn	1A	1B	2A	2B	Total
Adult magazines, for pictures, sections for children, etc., such as in *Life, Good Housekeeping,* etc.	23	24	20	13	22	102
Children's magazines, e.g. *Child Life*	4	7	11	9	15	46
Mickey Mouse	21	24	17	15	24	101
Funnies	23	24	22	12	27	108
Story Parade	4	2	4	1	4	15
Others					1	1
	75	81	74	50	93	373

Number of parents giving

1 answer only	15	
2 answers only	45	
3 answers only	58	
4 answers only	22	85
5 answers only	5	
	145	

21 *What types of stories are preferred?*

Number answering 148
Number not answering 4

Do-It Books	113	Humor	41
Animal	112	Travel	40
Snow White[3]	112	Toy	39
Fairy	98	Picture, with very little text	36
Comics	81	Riddles	35
Nature	44	Jokes	35
Poetry	71	Folk lore	35
Mother Goose	66	Patriotic	30
Children's experiences	66	Plays	21
Adventure	63	Big Little Books	19
Quintuplets	56	Stories with much repetition	19
True, realistic	55	Biography	15
Informational	54	About movies	13
Fables	51	About radio	10
Historical	50	Others	2
			1512

Number of parents indicating		
1 type only	2	15
2 types	4	
3	1	
4	4	
5	4	
6	14	
7	12	
8	11	
9	12	
10	14	
11	16	
12	12	
13	6	
14	11	
15	4	
16	4	
17	3	
18	3	
19	1	
20	2	
21	4	
22	2	
23	0	
24	0	
25	0	
26	0	
27	2	
Total	148	

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[3] The film *Snow White and the Seven Dwarfs* had been shown in the theaters only a short while before the questionnaire was sent to the parents, and the market was flooded with all sorts of books giving the story

22 *How does the child secure his books?*

Number answering	142	
Number not answering	10	
Gifts of parents		137
Gifts of relatives and friends		121
Selects them himself		49
Selects them from libraries		31
Borrows them from friends		18
Total		356
Number of parents checking 1 item only	5	
2	72	
3	43	
4	18	
5	3	
Total	141	

23 *Please list the books your child owns. Star those he reads or looks at most frequently*

COMMENTS

The replies to Question 20 show that the "funnies," Mickey Mouse, as separately named in the check list, and adult magazine pictures and sections for children, were the favorites, with no apparent grade differences. Children's magazines were indicated as of increasing interest to the older children. More than half of the parents answering this question checked three or more types of magazines. Apparently the interests of these children were widely spread over most of the magazines that were available to them in their environments.

Because of the long list of items given in Question 21 and also because no great differences were found, the grade counts of stories preferred are not shown. The only item that showed any marked tendency to change from grade to grade was the Mother Goose Rhymes, for which the decreasing preference was indicated as follows: *Kdn*, 18, *1A*, 18, *1B*, 15, *2A*, 6, *2B*, 9.

The total number of answers to this question was 1512. All but four parents replied. One hundred and thirty-three checked six or more types of stories, the six leading ones being: Do-It books, 113; animal stories, 112, Snow White, 112, fairy stories, 98; comics, 81; and nature stories, 74. The conclusion seems to be that the range of interest in types of stories seems limited only by the supply of story material available to the children. That this tended to be so at all grade levels is indicated by the average number of types of stories checked by the parents, the numbers being *Kdn*, 10.1; *1A*, 5.3, *1B*, 11.0; *2A*, 8.7; and *2B*, 11.3.

The replies to Question 22 show that the great majority of books owned by the children were gifts of parents or other relatives and friends. This obviously means that they were the books thought by adults to be interesting to or valuable for the children to read, rather than the proven choices of the children themselves. Of course, in many instances the adults probably gave books because the children had shown a liking for them. But undoubtedly, also, in many cases the good of the child rather than his interest prompted the bestowal of a gift book.

The data from the replies to Question 23 are given more fully in another report.[3]

24. (*a*) *Does the child seem to have any reading difficulty that has occurred repeatedly?*

No	71
Yes	8
A little	2
Not particularly	1
No answer	70

(*b*) *If so, describe.*

Three answers only were given.

25. (*a*) *Does he like frequently to retell any stories?*

Yes	74
No	27
No answer	51

(*b*) *Which ones?*

	Titles or types	Kdn	1A	1B	2A	2B	Total
Total	63	30	20	14	19	26	109
Number replying "All"		3	4	3	1	4	15

COMMENT

No grade differences were conspicuous. The most commonly named stories were: Snow White, 7, Fairy stories, 7, animal stories, 6, Three Bears, 4, Little Red Riding Hood, 4, Jack and the Beanstalk, 4; nature stories, 4, adventure stories, 3. Twelve other stories or types were named twice, and 41 were named once. The ones most frequently named were indicated at all grade levels.

Questions 26 and 27 were intended to bring out, if any, the influences of brothers, sisters and playmates on the reading of the children of the investigation

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[3] To be completed separately.

26 *How do his reading activities differ from those of his brothers or sisters when they were his age?*

Similar	5
Like oldest	6
Only child	15
No answer	126

27. *In what ways do his brothers, sisters, and playmates seem to influence his reading?*

Various answers	51
None	10
No answer	91

Friends helpful	14
Older sister helpful	5
Younger sister helpful	2
Older brother helpful	8
Younger brother helpful	2
They (probably sibs) helpful	17
Playmates told him reading was hard and frightened him	1
Playmates distract	1
Self-conscious before them	1
Total	51

COMMENTS

So few parents answered Question 26 that no other statement seems justified than that the question was inappropriate for the persons queried. Only 61 parents answered Question 27 Of the 51 who indicated influences of some sort, 14 reported that friends and playmates favorably influenced the reading of their children, and two had unfavorable influences Thirteen other statements indicated that siblings were helpful and 17 more that "*They*," who were probably siblings in most instances, were helpful The conclusion seems to be that either other children had far less influence than adults, or that the parents failed to discern the presence of such influences

The dramatic interests and activities associated with reading were examined by Questions 28, 29, and 30

28 *Has he ever expressed a desire to be like a character he has read about?*

Yes	111
No	8
No answer	33

Cowboy	41
Princess (prince)	31
G-man	30
Policeman (especially mounted, 1)	28
Nurse	25
Fairy	17
Highwayman	5
Others	
Doctors	9
Teacher	4
Mother	3
Aviator	3
Six others, 2 choices each	12
Twenty-three others, 1 choice each	23
Totals—32 characters	231

29 (*a*) *Has he ever "acted out" any of the stories he has read?*

	Kdn	1A	1B	2A	2B	Total
Yes	19	14	7	9	17	66
No	7	8	18	4	9	46
No answer						40

(*b*) *Which ones?*
Titles and types

	Kdn	1A	1B	2A	2B	Total
Totals 67	37	21	24	13	31	126
Most commonly mentioned						
Snow White	6	4	7	3	6	26
Little Red Riding Hood	4	1	1	3	3	9
Almost all, anything	2	1	1	2	1	7
Hansel and Gretel	1	2			1	4
G-Men		1	1	1	1	4
Little Black Sambo	1	2				3
Mickey Mouse	1	1			1	3
Robin Hood	1		1		1	3
Cowboy Tales	1		1	1		3
6 titles or types were named 2 times						12
52 titles or types were named 1 time						52
Totals—67 titles and types						126

30 *Was this dramatic play with other children, puppets, dolls, paper dolls, toys, imaginary playmates, others (indicate)?*

	Kdn	1A	1B	2A	2B	Total
Number answering	15	13	14	7	12	61
"No" answers	2	0	0	1	0	3
Not answering	20	23	17	10	19	88

Other children	11	15	11	3	12	52
Imaginary playmates	6	7	8	7	7	36
Dolls	7	4	1	3	6	21
Toys	5	5	3	1	6	20
Puppets	5	4		2	3	14
Paper dolls	2	3	2		3	10
Parents, nurse, maid	5			1	1	7
Alone	2			1	2	5
Self-drawings	1					1
Self-made props	1					1
Dog					1	1
Totals — (12)	45	38	27	17	41	168

COMMENTS

The total number of choices given in answer to Question 28 and the variety of characters that aroused imitative desires in the children, indicate a considerable effect—temporary or more prolonged—of what the children read upon their ideals, standards, or behavior Possibly the reverse effect also took place, namely, they may have been especially interested in reading about these characters which they most strongly wished to be like

The answers to Question 29 showed that less than half of the parents believed that their children had ever acted out any of the stories Grade differences were not pronounced There may have been differences in the interpretation attached to the term "acted out," but that would probably have affected all grades more or less in the same way. Sixty-seven titles or types of stories were named by the parents a total of 126 times Only Snow White was named more than a few times Variety, rather than favoritism, except for Snow White, seemed to be the rule in connection with acting out stories

Sixty-one of the 66 parents answering Question 29 described with whom or with what their children acted out the stories There seemed to be no grade level differences of significant consequence Twelve items (six in addition to the six suggested in the question) were indicated a total of 168 times If the five answers "alone" are included, there were just 100 answers naming human individuals, although 36 were imaginary ones The small number of adults participating in this dramatization of children is food for thought Probably convenience had a good deal to do with it, but, in comparison with the amount of story-telling and story reading done by parents, this very small amount of cooperative acting requires other reasons to account for it

The three questions indicate that dramatic interests and activities of these children were very important in connection with their early reading progress, that they were very varied, and that parents and other adults entered into these matters almost not at all

Interests in the radio, movies, and comics were investigated by Questions 31, 32 and 33

31 (*a*) *What programs on the radio does he prefer?*

	Kdn	1A	1B	2A	2B	Total
Number answering	27	35	27	16	31	136
Number not answering	10		4	2		16
Number answering "none"	2	2	1		2	7
Characters and types						
Uncle Don	9	12	9	7	8	45
Lone Ranger	5	7	6	3	3	24
Musical	9	5		11	6	21
Singing Lady	3	4	4	3	2	16
Jack Benny	1	4	3	2	5	15
Dick Tracy	2	3	1	2	4	12
Orphan Annie		1	4	1	6	12
Children's programs	2	1	5	1	1	10
Charlie McCarthy			3	1	5	9
News			1	1	4	6
Joe Penner	1		1		3	5
Let's Pretend	1	1			3	5
3 were named three times						9
6 were named two times						12
48 were named once						48
Totals — (68)	40	49	54	26	80	249
Average per grade	1 1	1 4	1 7	1 4	2 6	

(*b*) *Which ones does he listen to regularly?*

Characters and types	Kdn	1A	1B	2A	2B	Total
Uncle Don	3	8	5	5	6	29
Lone Ranger		3	6	1	1	11
Singing Lady		1	5	2	2	10
Charlie McCarthy	1	1	3	1	3	9

Musical	3		4	1		8
Jack Benny		4		1	2	7
Orphan Annie		1	2		3	6
Tom Mix		2	1	1	2	6
Let's Pretend	1	2			2	5
Dick Tracy		2	2		1	5
Horn and Hardart	2	1			1	4
2 were named three times						6
2 were named two times						4
21 were named once						21
Totals — (36)	16	34	35	14	32	131

(*c*) *Who are his favorite radio stars?*

Characters and types	Kdn	1A	1B	2A	2B	Total
Uncle Don	1	5	5	3	5	19
Charlie McCarthy	1	1	6		7	15
Lone Ranger	1	3	5	1	2	12
Jack Benny		14	4		6	11
Eddie Cantor		2		1	6	9
Joe Penner			3		4	7
Fannie Brice				1	3	4
3 were named 3 times						9
3 were named 2 times						6
32 were named once						32
Totals — (45)	7	16	35	14	52	124

Comments

One hundred and thirty-six parents reported on this question, only seven of them answering "none" The 129 naming programs gave 249 answers, indicating 68 different characters or types of programs. No significant grade-level differences were shown for the most popular programs The number given, however, does show a much greater interest by *2B* pupils than by any other groups, all of which had practically the same average number of preferred programs Forty-eight of the programs were named once only by 48 different parents Those included such things as What's My Name?, classical music, amateur hour, sketches, Hill-Billy, circus, Fred Allen, political speeches, Fannie Brice, Shakespeare plays, etc

The second part of the question indicates that a much smaller number of children listened to programs regularly There was substantial agreement on the first and second part of the question

Nine of the 12 preferred programs named in Part (*a*) were also named in Part (*b*), as the programs the children listened to regularly.

The third part of the question gives almost the same number of answers as Part (*b*) but shows a curious and marked difference. Four stars named in Part (*c*)—Uncle Don, Charlie McCarthy, Lone Ranger, and Jack Benny—were also reported in Parts (*a*) and (*b*). Charlie McCarthy, however, jumped up to second place in Part (*c*) as favorite radio star, whereas in Part (*a*) of the question he was in Position 9, and in Part (*b*), in Position 4. Furthermore, Eddie Cantor, Joe Penner, and Fannie Brice, three whose names did not appear among the most popular choices in the first two parts of the question, were in Positions 5, 6 and 7 respectively in Part (*c*).

The explanation of these differences is probably quite involved. One factor, however, would seem important. Perhaps the children, being still of young age, were compelled by shortage of radios, domination of parents, or amiability, to listen to other people's preferred programs. It is also possible that parents may have been deceived as to their children's real preferences by reading into their judgments about the matter their own likes. No doubt many children by listening, laughing, and by words, expressed approval of many programs and stars they had to listen to, because some one else had selected the program. Furthermore, some children probably did enjoy programs simply because their parents did so.

32 (*a*) *Does he go to the movies regularly, occasionally, seldom, or never?*

	Kdn	1A	1B	2A	2B	Total
Regularly		1		1	3	5
Occasionally	10	11	15	3	17	56
Seldom	19	17	10	12	11	69
Never			2			2
Not answered						20
Total	29	28	27	16	31	152

(*b*) *If he attends, what kinds of movies does he prefer?*

Number answering 126

Number not answering 26

	Kdn	1A	1B	2A	2B	Total
Animated cartoons	21	26	23	13	25	108
Shorts	7	6	8	6	8	35
Travelogues	7	3	9	6	15	40
Feature pictures	4	6	6	6	14	36
Total	39	41	46	31	62	219

(*c*) *Describe the types he prefers more fully*

Types	Kdn	1A	1B	2A	2B	Total
Shirley Temple	7	4	4	1	3	18
Cartoons	3		3	1	5	12
Mickey Mouse	2	3	1	5		11
Child actors		1	2	5	2	10
Snow White	4		4	1	1	10
Musicals	2	2	1		3	8
Adventure		1	2		5	8
Cowboy	1	2	1	1	1	6
Animals	1	1	1	1	2	6
Comedy, humor	1		2	1	1	5
Walt Disney	3		1	1		5
2 were named 4 times						8
3 were named 3 times						9
12 were named 2 times						24
24 were named 1 time						24
Totals (52)	40	25	40	23	36	164

(*d*) *Who are his favorite movie stars? Why?*

Number answering	81
Number answering "none"	12
Number not answering	59

Favorites	Kdn	1A	1B	2A	2B	Total
Shirley Temple	8	9	17	3	13	50
Deanna Durbin	2	3	4	1	5	15
Jane Withers		2	3	1	4	10
Sonja Henie	1		4	2	2	9
Mickey Mouse	1		3	1	4	9
Mickey Rooney		1	1	1	4	7
Freddie Bartholomew		1	3		2	6
3 were named 4 times						12
2 were named 3 times						6
4 were named 2 times						8
25 were named 1 time						25
Total (41)	17	22	49	12	57	157

COMMENTS

Only 20 parents did not answer this question This number added to the two who reported that their children never went to the movies (both 1*B* pupils), indicates that the motion pictures were a considerable source of interest to the young children of this study. Only five, however, attended "regularly," a term unhappily not very clear, and only 56 went occasionally Grade trends showed increasing attendance with age, but not a great difference. Eleven of the 31 1*B* pupils were reported as "seldom" going to see the pictures

Part (*b*) asked for check on four general types of movies Animated cartoons were far and away the most popular, having practically as many choices as the other three put together These other three showed no marked differences as children's preferences, except by the 2*B* children, who had increased interest in travelogues and feature pictures

Part (*c*) was designed to secure fuller analysis of the answers to Part (*b*). The results were not very helpful Apparently the parents had difficulty in finding appropriate words to describe more fully the general types of movies their children liked Some used descriptive terms, such as *romance, comedy, adventure,* etc , others the names of stars, especially Shirley Temple and Deanna Durbin, and others the subject matter of the pictures, such as boats, battleships, fires, etc A better question statement, including a check list of terms, might have been more revealing Fifty-two different descriptions were given a total of 164 times, and all grade levels were about equally represented

Favorite movie stars were indicated 157 times by 81 parents responding In addition, 12 parents reported no favorites. Each grade level was well represented, perhaps the second grade children showing more interest than the others, although the total for the 2*A* was low and that for the 1*B* was high Shirley Temple was the outstanding favorite, followed by three other girl stars Possibly this reflects the sex of the parent responding Little, if any, grade-level differences were shown by the figures. There were 41 stars named, only the seven given in the tabulation above receiving more than four choices. Among the miscellaneous choices were Eddie Brown, Popeye, Lone Ranger, Ritz Brothers, Nelson Eddy, Maureen O'Sullivan, Joan Davis, and Jeannette McDonald

The question *"Why?"* was added to the request for the names of movie stars. Very few attempts were made to answer this query Most of those which were given sound adult rather than childish in their appraisal of the stars Such terms as *"child prodigy," "enjoys singing and dancing," "humor," "good acting," "dashing and adventurous," "talent in mischievousness," "curls," "beautiful and graceful,"* suggest adult judgments This tendency of parents to project themselves into their children's experiences and thus to interpret their children's motives, thinking, and feeling is a failing too well recognized to necessitate long discussion here On the other hand, it is entirely possible that a second grade or even a kindergarten pupil may like Jane Withers, for instance, because she is "cute" in something of the same sense as the mother thinks so. The number *of reasons given by grade levels was Kdn, 5, 1A, 5, 1B, 4, 2A, 0, 2B,* 16

33 (*a*) *Which are his favorite comic strips?*

Number answering 111
Number answering "none" 7
Number not answering 34

Characters and types	Kdn	1A	1B	2A	2B	Total
Mickey Mouse	3	6	5	1	3	17
Katzenjammer Twins	4		5	1	6	16
Dick Tracy	2	4	1		7	14
Popeye	2	2	3	3	2	12
Jiggs and Maggie	1	4	2	1	2	10
Peter Rabbit	5	2		1	1	9
Blondie	1	1	3	1	2	8
Skippy		2	2	1	1	6
Mary Mix-up	2	1	2		1	6
Flash Gordon	1	4			1	6
Smiling Jack	1	1	1		3	6
5 were named 5 times each						25
4 were named 4 times each						16
6 were named 3 times each						18
11 were named 2 times each						22
36 were named 1 time						36
Totals (73)	39	44	44	22	78	227
Total number of comics named	25	22	28	19	15	

(*b*) *Where are they found?*

Number answering 100
Number not answering 52

New York American	22	101
The News	17	
Herald Tribune	14	
Mirror	11	
The Journal	10	
World-Telegram	9	
The New York Sun	6	
Newspapers	12	

Movies	5
Comic books	5
Magazines	1
Drawing set	1
Totals (11)	113

COMMENTS

One hundred and eleven parents replied that their children had favorite comic strips The distribution was large for all grade levels, the *2B* group showing, however, a definite rise in interest not apparent before that level Seventy-three different characters were named as favorites 227 times The first half dozen had nearly the same number of choices There was little evidence of grade differences among the ranking favorites

The replies to the questions asking for the sources of the comic strips preferred by the children brought out the interesting fact that nearly all children used newspapers The movies were named but five times, and comic books but five times This latter source has, during the last few years, grown by leaps and bounds as a hard-pressing rival of the comic sections of the newspapers Apparently these young children had not yet sought it very generally

The replies to the questions on the radio, movies and comics indicate their dominating part in the interests of the young children studied. Great variety, rather than limitation of interests to a few characters or types, seems to be the nature of these children's interests The obvious suggestion to methodology is that, if children's interests are to be used in teaching them to read, then their interests in materials of or like the radio, movies, and comics should be generously drawn upon Of the three, it would seem that the comics offer the greatest opportunity because structurally they are reading materials These should be used only with careful guidance, however, as it has been shown that "the English of the comic cartoons was carried over into the language of the children too often to be attributed to chance" (1)

This conclusion seems particularly impressive in the light of the relatively rich and controlled home and other out-of-school interests in the lives of the privileged children here studied For children less well provided with varied and wholesome interests and activities, the radio, movies, and comics occupy an even more dominating place in their experiences (3)

Two questions sought information upon the effect of others than parents upon the children, and that of other languages than English.

34 (*a*) *Is the child cared for by a nurse or governess?*

Yes	60
Nurse	11
No	59
No answer	22

(*b*) *If so, for how long has this been the case?*

Always	35
3 years	7
1 year	45

(*c*) *What has been her influence on the child in regard to reading and language?*

Good	12
No influence	8
No good	6
German	4

35 (*a*) *Has the child had contact with language other than English?*

Yes	63
No	60
No answer	29

(*b*) *If so, describe*

French	27
German	21
Norwegian	3
Italian	3

COMMENT

A large proportion of these children were influenced by nurses or governesses, but the effects reported were too meager to be of any value Either the parents were unwilling to comment on this question or unable to come to a conclusion. These factors of other language and of parent substitute are so complicated by superior provisions of living condition and, probably, of mental level, that they would be very difficult to determine without much more extended and careful investigation

36 *What other factors besides those already indicated have influenced your child's reading outside of school? Describe*

Play groups	27
Classes	13
Language	
Religion	
Dramatics	
Arts and Crafts	
Story hours at museums	
etc	
Others	
Number answering "none"	10
Number not answering	102

The small number of replies to this question indicates that the parents were aware of few or no other factors which materially influenced the reading activities of their children

SUMMARY AND CONCLUSIONS

Data on reading interests of children in kindergarten and first and second grades of the Hunter Model School, were secured from parents by means of a questionnaire The pupils came from homes of superior privileges. The parents' replies to many of the items were, doubtless, somewhat affected by lapse of memory, by natural parental bias, and by other subjective factors which may have weakened the validity of their testimony However, the teachers of the children concerned felt that the replies were of value and in general quite valid There were evidences of "internal consistency" and efforts to be accurate in the data when they were tabulated and analyzed

The main conclusions suggested by the replies are:

1 These children evinced an interest in reading long before entrance into school

2 They were interested both in the materials of reading and in learning to read.

3 In mastering the mechanics of reading these children were definitely interested, among other things, in letters and numbers.

4. Home provisions probably favored early reading interests, since at an early age many children's books were available and adults read and told stories to them

5 Reading preferences of the children, as adjudged by the parents, were varied and showed only small grade-level differences.

6 Many books were owned by the children and most of them were gifts from parents, relatives, and friends

7. Parents reported that reading difficulties were rare

8 Dramatic play with real and imaginary children, but not with parents or governesses, was common.

9. A considerable variety of favorite radio programs and stars, of movies and actors, and comic strips and characters, was reported Grade-level differences were not striking, although the *2B* children seemed to be extending their interests quite definitely beyond those of the *2A* and other younger groups.

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The Journal of Genetic Psychology, 1941, 58, 391-405

PERSONALITY CHANGES ACCOMPANYING ORGANIC BRAIN LESIONS: III. A STUDY OF PRE-ADOLESCENT CHILDREN*

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A. GENERAL STATEMENT OF THE PROBLEM

The three cases to be considered in this study were children of from 12 to 13 years of age, patients at the Montreal Neurological Institute. In all three the presence of a large organic brain lesion had been established clinically. Since the lesions were of very different kinds, and the psychological picture presented by the children also strikingly different one from the other, we are presenting the cases in detail. Our purpose is to correlate the known anatomical and physiological data with the behavioural and intellectual characteristics of the children, as evidenced in psychometric tests, by the Rorschach method of personality evaluation, and in the comments from the parents and nurses.

While a more detailed discussion of the organic conditions will be given in each case, we may epitomize the different anatomical pictures as follows: *Case 1*, a well localized, non-cortical lesion which had produced no increased intracranial pressure; *Case 2*, a large infiltrating lesion of the cerebellum and midbrain, which had produced a marked increase of intracranial pressure; *Case 3*, a large diffuse area of atrophy with a localized epileptiform focus in the left hemisphere, parietal-temporal-occipital region.

Table 1 gives a brief résumé of the principal clinical facts and psychological procedures.

B. THE PSYCHOLOGICAL DATA

The psychological data concerning these three patients are derived from several sources.

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*Accepted for publication by Leonard Carmichael of the Editorial Board, and received in the Editorial Office on February 6, 1940.

TABLE 1

SUMMARIZING CLINICAL FACTS AND PSYCHOLOGICAL PROCEDURES

Case	Age	Clinical diagnosis	Operative procedure	Preoperative psychological investigations	Postoperative psychological investigations
1	12	Epithelioma of the craniopharyngeal pouch	Removal of tumour by Dr W. Penfield	Binet (*L*) Kohs blocks Rorschach Parent's comments Nurses' comments	Binet (*M*) Kohs blocks Rorschach Parent's comments Nurses' comments
2	13	Astrocytoma of the cerebellum and brainstem Increased intracranial pressure		Binet (*L*) Rorschach Parent's comments	
3	12	Seizures Porencephaly left parietal-temporal occipital region	Removal from par-temp-occ region by Dr Elvidge	Binet (*L*) Kohs blocks Rorschach Parent's comments Nurses' comments.	Binet (*M*) Kohs blocks Rorschach Parent's comments Nurses' comments

1. Each child was examined by the Binet (Form *L*) and the Rorschach method of personality evaluation, when first admitted to hospital In addition to these, Cases 1 and 3 also took the Kohs blocks performance test After operation, when a full recovery had taken place, a similar examination was given (Cases 1 and 3)

2. Further information concerning the patients was obtained from the parents, with reference to both pre- and postoperative behaviour

3. Clinical observations, and notes made by the nurses on the children's behaviour in hospital were also obtained

4 A valuable addition to the study was afforded by the "blind analysis" of each child's Rorschach record by F R Miale of New York City For such an analysis, the complete Rorschach record, together with the sex and age of the child, was sent for a personality diagnosis, without reference to the problem concerned It should be noticed how the detailed personality descriptions fit in with the information concerning the children derived from other sources It must also be remembered that the Rorschach analyst

making such a "blind diagnosis" has never seen the children concerned, and has no way of forming a clinical opinion concerning them.

C. INDIVIDUAL CASE HISTORIES

1. *Case 1, Epithelioma of the Craniopharyngeal Pouch*

This patient, a 12 year old boy, had a history of periorbital headache for one year and a retardation of growth for two years. On admission to the Neurological Institute in March, 1939, encephalography revealed a "craniopharyngioma presenting marked calcification." Electroencephalography revealed "delta waves originating deep in the frontal regions . . . relatively normal cortical activity present from posterior head regions." On March 21, 1939, a "right frontal osteoplastic craniotomy and removal of tumour" was performed by Dr. Penfield. A further description of the tumour at operation is given by Dr. Penfield:

> This was an epithelioma of the craniopharyngeal pouch with a small amount of fluid anteriorly. A large amount of calcified solid material in the body of the tumour, and a cellular portion of the tumour posteriorly. Obviously the tumour must have been growing in a backward direction. It was definitely above the diaphragm of the sella, and had pushed the diaphragm downward. It had stretched the optic nerves greatly. The removal was apparently complete.

This patient made a good recovery.

a. Pre-operative, psychological examination.

1. Psychometric examination: Binet Form *L*, *IQ* 163; Kohs blocks, maximum score of 133. Rorschach examination substantiated the evidence of remarkable intellectual capacity and maturity, emphasized the withdrawal into himself, and the lack of all social contacts of an unduly introverted personality.

2. The reports from this patient's parents may also be considered as dealing both with the strictly intellectual, and the more general personality picture. Concerning the first the mother writes:

> "He has always been very bright and intelligent and has done very well at school, being away ahead of most boys of his own age in lessons. Studying has always come easily to him. He is quite a dreamer, and will sit for a long time with his thoughts

> apparently far removed from his surroundings" Concerning other aspects of his personality she writes "He has always been of a shy and rather retiring disposition, he makes very few real friends I could almost count on one hand the few that he is really intimate with Outside of books and music, of which he is very fond, we find it difficult to keep him occupied He is not much interested in outside sports, or mechanical things as so many boys are For the last two years especially he has been very quiet, and far more inclined to sit and listen to the grown-ups conversation than be outside with his brother and other boys"

3 Interesting comments, concerning this boy whose unusual maturity was really striking in everyday occurrences, are made by the head nurse, for example "He complains very little, he is calm, quiet, self-possessed beyond his years" and again "He is extremely reticent, controlled, bright and cheerful. Extremely cooperative"

4 The blind analysis of the preoperative Rorschach record is given here

> *Report from F R Meale on the Rorschach blind analysis*
> (Record 1)
>
> This is the Rorschach record of an exceedingly brilliant boy whose intellectual development has gone so far beyond his social development, that his whole life goes on within himself there is no contact at all with his surroundings The discrepancy between his introversial and extroversial developmental level is so great and so striking that one gets the impression that more than the accident of a particular psychological life situation has been at work
>
> Furthermore, one gets the impression that the boy has not always been so withdrawn This impression is derived from two sources in the record First of all, the factors indicating his *basic* emotional capacities all point consistently in the direction of a personality which is "ambi-equal," a personality, in other words, that has the potentialities for a balance between inner and outer living The second indication that the tremendous introversion is not part of the basic personality set-up is the quality of his introversial reactions For they are not the infantile reactions of the individual who has no contact with reality Rather they constitute a phantasy and a creative imagination of a very high, quite mature order
>
> He is very ambitious, but his intellectual and creative capacities are so great that they go beyond even his ambition, thereby

leaving him with creative abilities which have no outlet in expression Thus the creativity is turned back on himself, takes the form of preoccupation with the inner workings of his own mind, making him withdraw more and more from social contacts and affective living

The great danger is that the boy will be inundated by his phantasy, and lose all contact with the real world For he has now little conscious control, and no real relationship with others, to balance the tremendously powerful urges that arise from within

There are several hopeful signs, however, of factors in the personality which keep the connection with reality (*a*) The boy's thinking is logical and orderly, while not rigid (*b*) The "index of stereotypy" is at an optimal level (*c*) His strong phantasy does not lead him into esoteric fields, he is able to conform to the demands of convention, and possesses common sense

To return, therefore, to our impression that there is some specific factor in the patient's life at present that is causing so drastic a withdrawal from emotional involvement with his surroundings, one might venture to suggest that if this factor, whatever its nature, could be removed, the boy could be set on his way to a healthy and productive development

b Postoperative, psychological examination

1 Psychometric examination Binet (Form *M*) *IQ* 168, Kohs blocks, maximum score 133 Rorschach examination revealed essentially the same personality structure, with the characteristic introversion, and intellectual maturity but gave evidence of the patients having undergone a drastic psychological experience concerning which he was anxious and apprehensive

2 The postoperative comments of the parents are that.

> There is little or no change in him at all, except in a few things that are the result of weakness and rundown nerves I think He has very little resistance or nerve to bear pain or hurt As you may know he has to have "hypo" injections all the time, and at times, the dread of them seems almost more than he can stand He used to go quite bravely to the dentist before his operation, for instance, and have a tooth pulled, all alone, but now the very thought of it makes him shudder

3 The nurses' comments reveal that, following a period in

which he was hypersensitive, irritable, impatient, showing behaviour in "sharp contrast to his calm, serene, almost stoical preoperative behaviour," he had returned to approximately his normal mode of reactions before leaving hospital

4. The blind analysis of the second Rorschach record is given here:

> While much of the basic personality structure remains the same, there are several striking changes evidenced in the second record The nature and content of the subject's inner life remains unchanged, as does his isolation from the environment The factor that has changed, however, has changed to a degree that is startling when one considers that the interval between the two records is a matter of weeks For in the space of approximately one month, a personality which lacked conscious control to an almost astounding degree, has assumed an emphasis on control which has progressed to the point of constriction, and threatens to throttle all spontaneity
>
> One may infer, therefore, that an anxiety-producing factor of great potency must have appeared in the subject's life during the interval between the two records For only such an occurrence could explain such sudden and drastic constriction Not only has the effort at control increased so markedly, but the content of the mental life of this brilliant boy has taken on evidences of stereotypy, and he no longer dares to be original
>
> It is impossible, however, that this constriction may lead ultimately to a better adjustment It may be that for a person as much at the mercy of his introversial urges as this boy has been, a necessary step in the development of social adaptation must be a period in which emphasis on intellectual control is the prime motivating power in the personality It may be, in other words, that before daring to deal with external reality, this boy has needed to try to get his dealings with his inner reality thoroughly under control.
>
> There are a number of factors in the second record which may be indicators of a positive development Outstanding among these factors is the increased flexibility in mental approach While in the first record details were often neglected for the sake of abstraction and generalization, there is in the second record a more healthy balance between ambitious generalization and the capacity to deal with the concrete details of everyday living There is also an increased emphasis on keen observation, and an increase in the variety of the content of his interests While this is in apparent contradiction to the pre-

vious statement that mental stereotypy increased, there is no actual discrepancy For the increase in flexibility has been in the direction of conformity, not of originality

Only further study of this boy, with, for example, another Rorschach record after six more months, will be able to indicate at all conclusively whether it is the anxiety and construction, or the increased flexibility which will ultimately triumph

2 *Case 2, Astrocytoma of Cerebellum and Brain Stem, Increased Intracranial Pressure*

This patient, a 13 year old boy, had a history of three months' headache and dizziness, and one month's vomiting Staggering gait had been noticed for four months

On admission to the Montreal Neurological Institute he was found to have increased intracranial pressure A suboccipital craniotomy performed by Dr Penfield revealed "an unusually large glioma which was not cystic and which infiltrated both the lateral wall of the fourth ventricle, and the floor . it penetrated a considerable distance into the medulla oblongata" The final diagnosis of "astrocytoma of the cerebellum invading the medulla in the caudal half of the floor of the fourth ventricle was made in this case.

Unfortunately this patient died, so that no postoperative psychological examination was possible

a. Preoperative, psychological examination

1 Psychometric examination revealed an *IQ* of 68 on Binet (*L*). Rorschach examination revealed marked constriction, and poverty of psychic reactivity: a record unmistakably indicative of the psychological disturbance found in cases of infiltrating tumour, and high intracranial pressure (1)

2 Comments from the parents revealed that this boy had been showing "emotional changes" for a year That he was also drowsy and untidy.

3 This patient was only in hospital for two days prior to operation, so that no comments from the nurses concerning his behaviour are available However, he presented clinically a superficially bright picture, not at all justified by the Binet score or the Rorschach evaluation

4 The blind analysis of the record is given here

> The personality revealed in this Rorschach record is clearly one that has been profoundly affected by an organic disturbance of the central nervous system. It bears a marked resemblance to the Rorschach records of adults with large cerebral tumours (1, 2). The personality is restricted entirely to the simplest and most primitive form of reaction, is altogether stereotyped, with no possibility of spontaneity. The intelligence is somewhat below the borderline between feebleminded and normal.

3. *Case 3, Porencephaly Left Parietal-Temporal-Occipital Region*

Pre- and postoperative psychological examination obtained. This patient, a 12 year old girl, had had seizures since the age of three.

Admitted to the Neurological Institute in March, 1939, when pneumo-encephalography revealed, "evidence of diffuse cerebral atrophy much greater in the left hemisphere. The posterior portion of the left hemisphere has been completely destroyed, particularly the occipital lobe, but also the parietal lobe." Electroencephalography revealed, "epileptiform focus in the left occipital pole, from this point delta waves are obtained almost continuously."

A left parieto-occipital osteoplastic craniotomy was performed by Dr. Elvidge, with removal of the focal epileptogenic area of the brain, including occipital lobectomy (see diagram of removal).

The patient made a very rapid recovery, and was tested a few days after her discharge from hospital, less than one month after the operation.

a. Preoperative, psychological examination

1. Examination by the Binet (Form *L*) gave an *IQ* of 56. The patient was unable to complete any of the items in the examination with the Kohs blocks. Rorschach examination revealed that despite the lack of intellectual control, and the grave emotional disturbance, that this patient had capacities much higher than were indicated by the Binet score, and the failure on the Kohs blocks.

2. Something of the behaviour problem which this child had presented is seen in the comments of the parents given in the case history.

> When a baby she appeared to be quite normal, even up to the age of 5-6 years old. But since that time she definitely seemed to be mentally underdeveloped, would laugh easily, cry easily,

would try to compensate for her lack of understanding, and lack of mental ability by overdoing her reactions in unexplained laughter exaggerated expressions of pain, etc . In play with other children, when they would try and avoid her, she would always seek leadership and would try to influence the others after her own will

3 Comments by the nurses on this patient show her as:

> Noisy, talkative, jumpy very uncooperative uncontrolled Having temper tantrums in which she screams, tosses herself about She is irritable, noisy and restless She threw a book at a patient who annoyed her

4 The blind analysis of this patient's Rorschach record is given here.

> This is the Rorschach record of a child whose basic capacities for intellectual achievement and even for emotional adjustment are probably above average However, some serious block to normal development has been present, and has interfered to a tremendous degree, so that her actual achievement level is very low, and her emotional adjustment altogether ineffectual The interfering factor has affected the whole personality, rendering the emotional control quite inadequate and leaving the child utterly exposed to affective stimuli So helplessly exposed to extroversial stimulation is this subject that there has been almost no opportunity to develop any inner stability with whom to counteract the affective lability Her inner life consists mainly of self-consciousness However, this self-consciousness is on a mature level that is in marked contrast to other aspects of the personality It has a large component of insight and realistic self-evaluation However, this insight into her own condition makes her situation even more difficult for her, and gives rise to strong negative behaviour in her relations to others

b. Postoperative, psychological examination

1 Examination on the Binet gave an *IQ* of 56 The performance on the Kohs blocks was an improvement over the preoperative failure she completed the first three items Rorschach examination reflected a change towards greater control, and indicated that a marked improvement in more adjusted social behavior could be expected

2. Two letters from the mother, two months, and four months postoperatively, give indication that this expected adjustment has come to pass The first reads, "On the whole she is more reasonable" . and concerning her ability. "Recently at school in a class of girls her own age, she won a prize for reciting the 14th chapter of St. John, Verses 1-6" The second letter comments, "She is decidedly improved . . much quieter and able to reason much better "

3 The comments of the nurses during her hospital period fall in line with these observations Such comments are

> She is much more cooperative, controlled, talks less foolishly She is more pleasant She is continuing to be quieter than before operation, more cooperative, less foolish, more interested and less violently noisy

4. The Rorschach record when subjected to a "blind analysis" indicates the following·

> While the second record is not that of a normal child, there is evidence of marked improvement The disturbance and conflict which at the time of the first record were all-pervading, now operate in a more circumscribed area of the personality, giving a picture of neurotic conflict rather than of a profoundly disturbed total personality Although the subject is still very labile emotionally, her ability to respond in an adjusted manner has increased greatly. She is not as self-conscious as she was, and there are some efforts, although they are still ineffectual, in the direction of the development of inner stability Despite the disturbance which is still a factor in this personality, and despite the fact that the intellectual achievement level is far below the basic intellectual capacities, she must now present a picture of near-normal social behaviour, in marked contrast to her previous explosive mode of response

D. Comparison of the Psychological Pictures of the Three Patients

It will be seen from a consideration of these three cases, that the psychological picture presented by each is very different Case 1 is that of an exceptionally brilliant boy for whom the presence of an organic lesion in no way interfered with his intellectual capacities While we are not prepared to say from this one case that the lesion in this location contributed directly to, or produced this precocious mental development, it might well be that some disturbance of pituitary or of hypothalamic function was a factor concerned While this is problematical it is very likely that the lesion indirectly affected the total psychological picture, for as a result of frequent headaches, and retarded physical growth this boy may well have been anxious to avoid the more boisterous play of children of his own age, and in consequence have retreated more and more into his own world Case 2 represents a superficially normal youngster who is shown psychometrically, however, to be barely normal, and whose personality structure as evidenced in the Rorschach, is identical to that found among adult patients with infiltrating brain tumours Case 3 shows a "behavior problem" child, noisy, uncontrolled, inadequately equipped intellectually to deal with her labile emotions. Operative intervention, and the removal of the focus giving rise to epileptiform waves, resulted in a social readjustment which was quite marked

E Summary and Conclusions

Three 12-13 year old children, with established organic brain lesions were examined psychologically The areas and types of the lesions were an epithelioma of the craniopharyngeal pouch, an astrocytoma of the cerebellum and midbrain, a diffuse atrophy of the brain with a localized epileptiform focus in the left parietal-temporal-occipital region Psychological examination consisted of the 1937 revision of the Binet (Forms *L* and *M*), the Kohs blocks, and the Rorschach method of personality evaluation, and was supplemented by reports from the parents and nurses

Three distinct psychological pictures were found preoperatively an exceptionally mature, intelligent introverted child, a restricted and stereotyped personality picture with low intelligence, and an overexcited, uncontrolled disorganized personality

In both cases where postoperative psychological examination was obtained, no damage to the intellectual level or personality structure was indicated In Case 1 the same exceptional performance was obtained postoperatively In Case 3, while the Binet score remained unchanged, the Rorschach indicated that a definite improvement in social adjustment might be expected This was amply confirmed by the parent's reports after several months Our general conclusion is that psychological study and the Rorschach method in particular, may lead to the discovery of consistent patterns of behavior accompanying different types of organic brain lesions

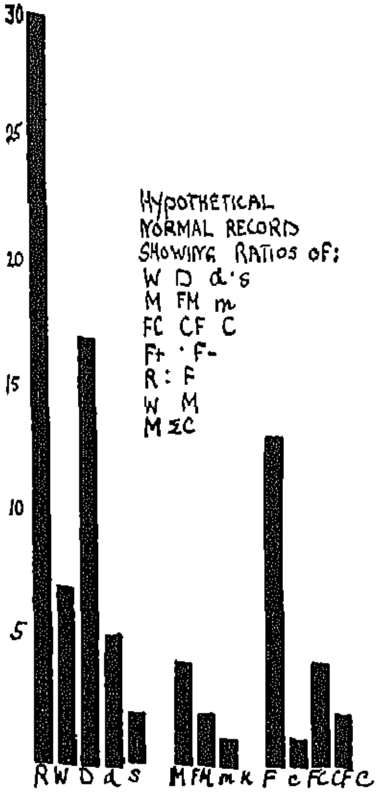

FIGURE 1

APPENDIX

A rather simple manner in which the personality pictures presented by these three children may be contrasted with each other, and with the record of a hypothetical normal, is achieved by comparison of the graphs given in the Figures 1-6 The scoring used is that of the Rorschach Research Exchange Although the hypothetical normal is that of an adult, and while more *FM* scores would be considered normal in a child of 12-13, the essentially normal person, child or adult, will have a personality picture with a distribution approximating that in Figure 1. The extraordinary introversion of Case 1, the poverty of the personality picture in Case

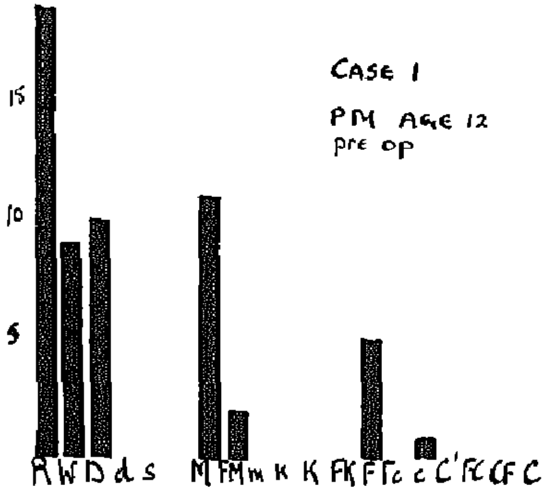

FIGURE 2

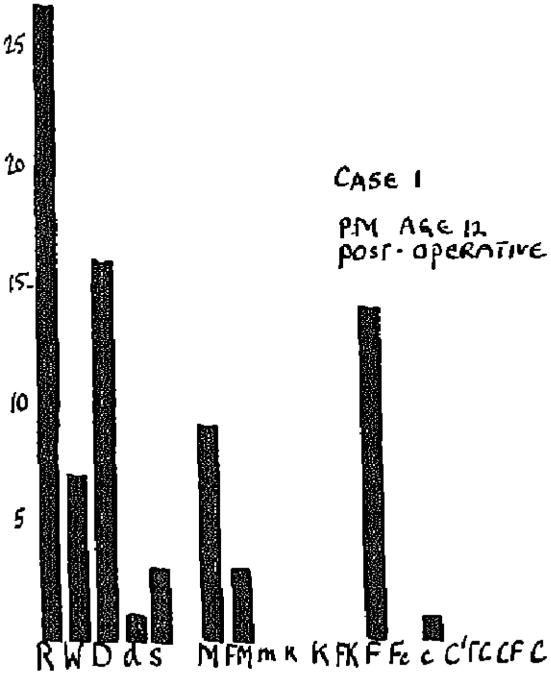

FIGURE 3

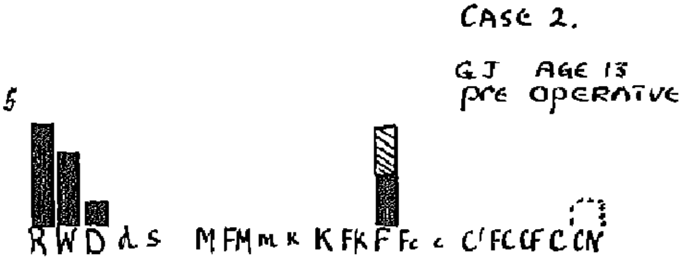

FIGURE 4

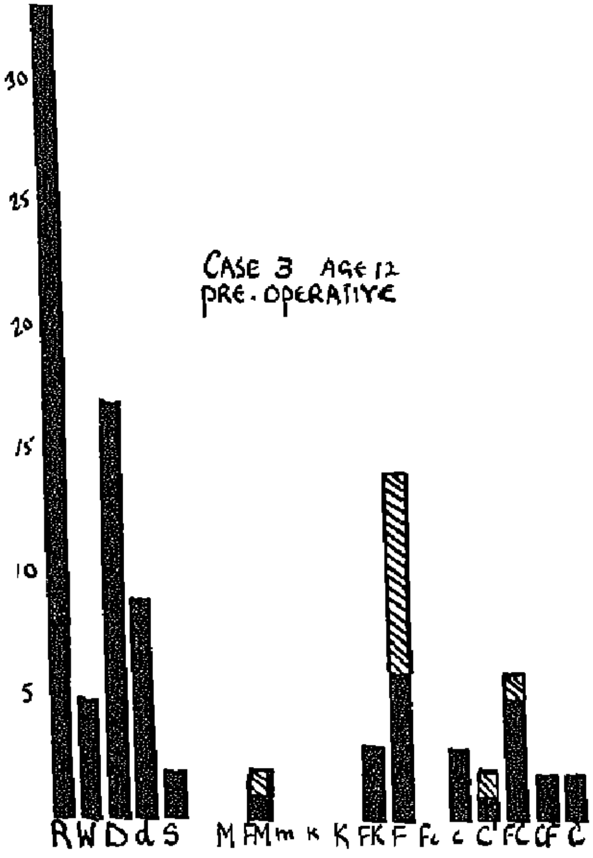

FIGURE 5

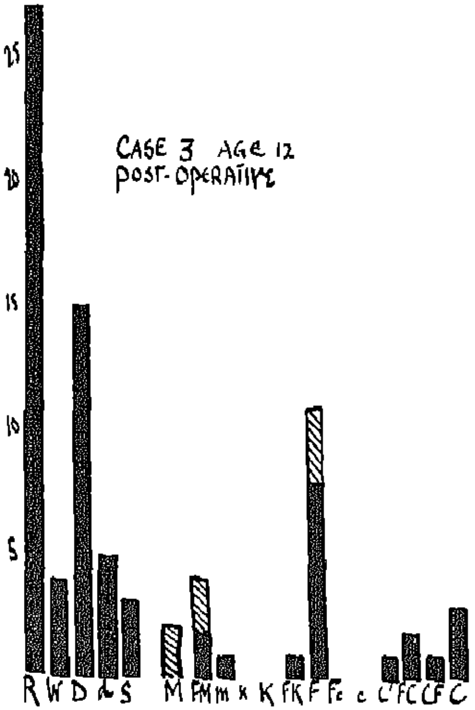

FIGURE 6

2, and the uncontrolled emotional responsiveness of Case 3, show up in marked contrast to the more "ordinary" well balanced normal

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The Journal of Genetic Psychology, 1941, 58, 407-417

LANGUAGE RESPONSES AND INTELLIGENCE I. VERBALIZATION AND INTELLIGENCE

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A. INTRODUCTION

Facility in the use of language has long been associated with high intelligence. Fascinating anecdotal explanations of the relationships of general ability to expertness in verbalization and rhetoric precede by many years the experimental investigations of this relationship. Bacon (2) has said "to him who has little or no knowledge on the subject proposed, places (methods, schemes) of invention are of no service, and on the other hand, he who is ready provided with matter applicable to the point in question will, even without art and places of invention (although perhaps not expeditiously and easily), discover and produce arguments." Experimental investigations of this relationship generally have shown ability to verbalize to go hand in hand with high intelligence.

Many writers before Bacon observed the relationship between general intelligence and linguistic ability. Three hundred years after Bacon's linkage of rhetorical perfection and intelligence, Binet (4) observed intelligence as directly related to the higher mental processes, and measured by the subjects' use of language, viz., completion of sentences, description of a picture, and description of an object. Much of the experimental work in the field of the measurement of intelligence, since the work of Binet, has been concerned with language and intelligence. It is the purpose here to note briefly some experimental references to the relationship between the use of language and intelligence, most of them appearing within the past decade.

The use of language by young children has contributed to conclusions about language and intelligence. Barke (3) found correlations between teachers' estimates of intelligence and verbal tests to average .45, and correlations averaging .28 between teachers' estimates of intelligence and performance tests. Fisher (8) found lan-

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*Received in the Editorial Office on February 13, 1940.

guage responses in preschool children closely associated with general development. Among normal and superior children, chronological age was more important than mental age in determining the various stages of language development. Girls were found to develop more rapidly than boys Borel (5) determined that some children who inconsiderately were diagnosed as backward in speech, but who actually were only delayed, are very teachable A relationship between intelligence and teachability is inferred Day (7) notes in a study of twins a retardation in language development, when the language is compared to that of single children The twins in the study were found to be approximately 10 points below the *IQ* of the singletons with whom they were compared Pyles (15) found verbalization to be a distinct aid in learning In a study of language patterns, Fisher (9) found a significant positive relationship between the complexity of sentence structure and the intelligence of the child He concludes that certain language patterns are developmental because of their closer correlation with chronological age than with mental age. Nelson (14) in a study of personality and intelligence found a correlation of 28± 06 between the Kuhlmann-Binet *MA* and spontaneous conversation, and a correlation of 20± 07 between the Merrill-Palmer *MA* and spontaneous conversation The correlation between spontaneous conversation and gross activity of the group is 43± 06 La Brant (12), in an investigation of language development, using the clause as the unit for study, draws some pertinent conclusions. She found that a high intelligence quotient does not appear to exert a marked influence in hastening the use of complex sentence structure. Chronological age does appear to exert an influence when mental age is constant The language skill disclosed by the group of superior adults studied is not attained, even from a structural standpoint, by the most superior of the high school students whose writing was used in this study Smith (16), using as criteria of improvement in speech of preschool children the average number of words per sentence, makes noteworthy observations She found mental age a more important factor in improvement than chronological age Sentence length was found to be indicative of size of vocabulary Kelley (11), in a study of factors in reading and speech disabilities, points out some structural relationships of interest He found individuals whose silent reading ability was low in relation to their general intelligence to be most deficient in the rhythm of their speech. Silent reading comprehension and speech comprehension were not found to be highly related. Loomis and Moran (13), in studying the relation between different parts of speech in written composition and mental ability, found a close correlation between language and intelligence. They found a correlation between the percentage of articles used and mental age of .52±.06, between percentage of articles and the vocabulary test score .48±.06, and between the percentage of articles and average school grades .51±.06. They also found that correlation coefficients between measures of mental ability and the use of articles are in most cases higher than correlation coefficients between the different measures of mental ability themselves. The correlation between percentage of connectors and mental age was .20±.07. Williams (17) found average correlation between language measures and intelligence of the order of .60.

Gates (10) stresses the fact that language abilities are not unitary—the language abilities of reading and spelling for example depend on the working together of a number of activities. Using over 300 children he found correlations between reading and spelling ability and 13 mental tests of various types. Word-perception had the highest correlation with reading and spelling ability, general intelligence came next. Colvin and Allen (6) found a relationship between linguistic ability and mental test scores. (A relatively complete summary of studies of language and intelligence, in the decade before 1929, is made by Adams and Powers, 1.)

B. Method and Results

Using test booklets of 1,095 Detroit Kindergarten Tests,[1] given to public school kindergarten children in midwestern cities over a four year period, an analysis of the test scores was made. One group of 734 tests given in city school systems of the middle west was used. Another group of 361 tests given to children in the Ames public schools was used. These latter tests were given by three examiners, 176 administered by the writer.

Data from the test booklets are presented in Table 1. Column one designates the examiner, two the number, three the mean score of Test 7, four the mean total score, five the standard deviation of scores on Test 7, six the standard deviation of the mean of

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[1] Detroit Kindergarten Test, Individual. H. J. Baker and H. J. Kaufmann, published by World Book Company.

TABLE 1

Examiner	N	M_N7	M_NT	$\sigma 7$	σ_M7	σT	σ_MT	r
				A				
1	65	3.00	18.40	1.26	16	4.18	52	.62
2	120	2.24	15.48	1.35	.12	4.31	39	64
3	176	2.70	15.96	1.51	11	4.77	36	67
C	734	2.77	16.45	1.43	53	4.85	18	68
				B				
1	29	3.31	19.00	1.31	24	4.51	.84	.50
1	30	2.73	17.60	1.20	22	3.85	70	71
2	26	2.23	16.19	1.63	32	4.81	94	74
2	32	1.97	15.38	1.23	22	4.48	79	51
2	32	2.47	15.50	1.24	.27	3.65	65	58
3	44	2.91	16.23	1.34	20	4.61	69	57
3	42	2.71	15.67	1.52	23	5.14	79	62
3	42	2.76	16.31	1.59	25	5.55	86	80
3	43	2.30	15.07	1.63	25	4.39	67	66

Test 7 scores, seven the standard deviation of the total scores, eight the standard deviation of the mean total scores, and nine the correlation between the score on Test 7 and the total score. Part *A* of Table 1 includes total number of tests by examiners, with those in other cities tabulated in the row indicated by Examiner *C*. All of these, however, were not administered by one examiner. Part *B* of Table 1 is an analysis of smaller groups of tests by examiners, tests administered in Ames. Data in Part *B* of the table are included in the totals in Part *A*. The analysis in Part *B* is in terms of smaller groups of tests administered in one school, in one week, or in one unit of time or locality.

Test 7 involves six items—line drawings of a teakettle with two spouts, a boy with a clock in place of a head, a house with a smoking chimney projecting horizontally from one wall instead of vertically from the roof, a shoe with two rows of buttons instead of one row, a child in bed with the child's head at the "foot" of the bed rather than at the "head," and a six-fingered hand holding a toothbrush. As the page (Test 7) of the test booklet is shown to the examinee, the examiner points to each item, saying, *"What's wrong with the teakettle? the boy?"* etc.

In 176 tests (Examiner 3, Part *A* of Table 1) the examiner noted verbal responses of the children being examined. In addition to having the children point to the "wrong" aspect of each picture, each child was asked questions designed to stimulate verbalization. Some of these answers are presented below.

A system of analyzing qualitatively the answers to questions regarding the items of Test 7 was devised. It was felt that grammatically superior answers would be given by children who attained higher total scores. It was felt further that children making greater use of words in higher age word levels would be the children of superior intelligence. Neither of these assumptions is correct—based upon results obtained from data presented here.

Teakettle. Correct answers to this item, for children in the highest quartile in total score, range from *"Too many pieces to pour water"* to *"It is supposed to have one spout."* Correct answers, for children in the lowest quartile in total score, range in expertness in the use of language from *"Take one* (pointing to spout) *off"* to *"One spout shouldn't be there."* Incorrect answers for those in the highest quartile are *"Won't cook"* and *"Wants to get off the stove"*; incorrect responses for those in the lowest quartile are *"Broken"* and *"Has water in it."*

Boy with Clock Head. Correct answers, verbalized, range from *"He has a tick-tock head"* to *"Shouldn't have clock on head."* Incorrect in the first quartile on total score start with meaningless *"Sick"* to *"Nothing."* Q_1 and Q_4 total scores bear no consistent relationship to correctness or incorrectness on this item.

House and Chimney. The relationship between total score and expertness in verbalization regarding this part of the test is more consistent, and more nearly in accord with the writer's original assumptions regarding language, than is the same relationship in the preceding items. Nearly all answers from Q_1 children were expert, from the standpoint of communication and the use of language. Examples are *"Chimney should be up there"* and *"Chimney is on the side."* Many Q_4 children answered, correctly, *"Fire out on side"* and *"Smoke in back."* Incorrect answers of *"Nothing"* occurred more frequently in the Q_1 group than in the Q_4 group, while meaningless *"Broke"* and *"House burning"* answers occurred as incorrect responses far more frequently for Q_4 than for Q_1 children. In the case of *"House burning"* answers, and others of similar vagueness, but scored as wrong by the examiner immediately upon hearing them, an attempt was made after administering the test to question the child further. Attempts were made by the examiner to be sure that a child did not, for example, construe *"House burning"* as an adequate answer to the question, *"What is wrong?"* in terms of feeling that the chimney had toppled off the roof, or slid over to the side, thus causing a fire. By persistent questioning, we were convinced that in no case, either with Q_1 or Q_4 children, was our scoring incorrect

Shoe A common incorrect answer by Q_1 children was *"No strings" "Too many buttons,"* when subsequently pursued by the examiner, was scored as correct, when it was evident from further questioning that the child had significant comprehension

Generalizations are not drawn from results on this item because of (*a*) difficulty in depicting a button shoe adequately by line drawing, and (*b*) complete lack of experience with button shoes of kindergarten children who started to school between 1930 and 1935. One superior child asked the examiner to turn the page of the booklet back to Test 7 when the test was finished, to ask a question about the shoe. After the examiner's explanation, the pointed remark, *"Well, I never saw buttons on shoes!"* was made

Girl in Bed Correct answers to questions about this item are of course infrequent. Inexpertly worded correct answers range from *"Bed has short end"* accompanied by explanatory pointing and gesticulating, to the cryptic *"Wrong way"* answer. Expertly worded answers range from *"Head should be there"* indicating a head-foot reversal, to *"Pillow at foot of bed."* There is not complete relationship of expertness in verbalization to total score. It is true that more of the linguistically immature answers are made by Q_1 than by Q_1 children in the incorrect answers, but incorrect answers indicating some kind of comprehension (*"No sides on bed"* and *"Wheels are gone"*) were made by both Q_1 and Q_1 children.

Hand with Brush This part of the test, of course, extremely difficult, had just two correct answers No correct answer appears for any except Q_1 children Only two of the Q_1 children replied, *"Six fingers"* Another Q_1 child giving as an incorrect answer *"Where is the arm'"* was found subsequently to react to the drawing as incomplete Another Q_1 child noted that *"One nail is gone"* because the drawing does not show the nail tip for the index finger On the whole this is an unsatisfactory test and fewer than eight correct answers occurred in the total population The other correct answers, from data not included in Table 2, are *"Too many fingers"* and *"One thumb with five fingers."*

TABLE 2

LANGUAGE RESPONSES TO ITEMS IN TEST 7

(The quartile in which the subject's total score places him is indicated following the answer. All answers are direct quotations. The occurrence of more than one Q bears no relationship to frequency of occurrence for the item. Q_1 is highest quartile.)

	Correct		Incorrect
	Teakettle		
1.	Two ends Q_1, Q_3	1	Nothing Q_2, Q_3, Q_4
2	Two of these (spouts, pourers) Q_1	2	(Incorrect) Wrong Q_2
3	Take one off. Q_4	3	Broken (broke) Q_2, Q_4
4	Two things Q_1, Q_2	4	No handle Q_4
5	It is supposed to have one spout. Q_1	5	One handle Q_3, Q_4
6	Too many pieces to pour water Q_1	6	Don't know Q_1, Q_2, Q_3, Q_4
7	Has two sides Q_4	7	Won't cook Q_1
8	Got two horns Q_3	8	Needs coffee Q_2, Q_3
9.	One spout shouldn't be there Q_1, Q_4	9	Spout cut there Q_4
10	Two holes Q_1, Q_4	10	Boiling Q_4
		11	Can't work Q_3, Q_4
		12	Wants to get off the stove Q_1
		13	Upside down Q_4
		14	Has water in it Q_4
	Boy With Clock Head		
1	Can't see his face Q_1, Q_4	1	(Incorrect) Wrong Q_1
2	Clock on head, on him Q_1, Q_2	2	Has hands and legs Q_4
3	Clock head Q_2, Q_4	3	Nothing Q_1, Q, Q_4
4	Clock face Q_1, Q_3	4	Clock Q_1, Q_2, Q_3
5	No head Q_1, Q_4	5	Don't know Q_1, Q_3, Q_4
6	Head is off Q_2, Q_3	6	Broke Q, Q_4
7	He has a tick-tock head Q_1	7	Sick Q_1, Q_4
8	Watch on head Q_2	8	Clock back of him Q_3, Q_4
9	He is a clock Q_3		
10	Shouldn't have clock on head Q_1		
11	No face Q_1		
12	Clock over his face Q_2, Q_3		
13	Clock there Q_1, Q_4		
14	Just like a clock Q_3, Q_4		
	House and Chimney		
1	Chimney should be up there Q_1	1	Steam out of it Q_3
2	Chimney is on the side Q_1	2	Nothing Q_1, Q_3, Q_4
3	Chimney wrong Q_1	3	(Incorrect) Wrong Q_4
4	Smoke out the side Q_1, Q_2	4	Smoke going out Q_3, Q_4
5	"Chimley" Q_3	5	Smoke is funny Q_4
6	Fire out on side Q_4	6	Broke Q_4
7	Chimney on back Q_3	7	House burning Q_1, Q, Q_4
8	Smoke in back Q_4	8	Don't know Q_1, Q, Q_3, Q_4
9	Chimney is not on top Q_1	9	Smoke Q_4
10	Chimney too low Q_4	10	Fire Q, Q_4
		11	No chimney Q_4

TABLE 2 (*continued*)

Correct	Incorrect
11 Chimney goes out Q_2, Q_3	12 Chimney pulls out Q_1, Q_4
12 Chimney comes out of window Q_1	13 Sick Q_4
13 Smoke stack on side Q_1, Q_2	14 Ghost been in it Q_3
	15 No one in it Q_2, Q_4
	16 Got windows. Q_4
	17. Furnace (stove) doesn't work Q_3, Q_4
Laced Shoe	
1 Bow down there Q_1	1 (Incorrect) Wrong Q_1, Q_2, Q_3, Q_4
2 Bow should be up there Q_1	
3. Tied at the bottom Q_1	
Button Shoe	
1 Two things. Q_1, Q_4	1 No strings Q_1, Q_2
2 Shouldn't have two buttons. Q_1	2. Don't know Q_1, Q_2, Q_3, Q_4
3 Too many buttons Q_1, Q_2	3 Nothing Q_1, Q_2, Q_3, Q_4
4 Buttons on both sides Q_1	4 Has buttons Q_2, Q_3
5 Should have one row of buttons Q_1	5 One row off Q.
6 Two on sides. Q_1	6 (Incorrect) Wrong Q_2, Q_3
7. Two rows of buttons. Q_1, Q_3	7 Two stripes down Q_4
	8 Never used Q_3, Q_4
	9. Buttons off Q_4
	10 Stripe Q_4
	11 Sick Q_4
	12 Never saw buttons on shoes Q_1
	13 Hard to get on Q_3, Q_4
	14 Can't get foot in it Q_2
	15 Lost a shoe Q_3
	16 Holes on each side Q_4
	17. Not on Q_2, Q_3
	18 No mate Q_1, Q_2
	19 Can't wear it Q_4
	20 Two shoes in each one Q_4
	21 Too big Q_4
	22 Too small Q_2
	23 A hole in it Q_4
	24 Ties should be there Q_2, Q_3
	25 Broken Q_2, Q_4
	26 Funny buckles. Q_2, Q_3
	27 Has nothing in it Q_4
	28 These things come off Q_4
	29 Wrong line on shoe Q_1, Q_2, Q_4
	30 Nail in it Q_4
	31 Has a rubber on it Q_2, Q_3
	32 Something in it Q_2, Q_4
	33. Tongue is sewed on there Q_1

TABLE 2 (*continued*)

	Correct		Incorrect
	Girl in Bed		
1	Head should be there Q_1	1	Don't know Q_1, Q_2, Q_3, Q_4
2	This littler than this. Q_2	2	Sick Q_4
3	Wrong way Q_4	3	Sleep Q_3, Q_4
4	This end higher Q_2, Q_4	4	Nothing Q_1, Q_2, Q_4
5	Bed has short end Q_1	5	Too long Q_4
6	Pillow at foot of bed Q_1	6	(Incorrect) Wrong Q_2, Q_4
7	Head of bed too low Q_1	7	Cover is round Q_3
		8.	Shouldn't be covered up. Q_2 Q_3
		9	She's lazy Q_2
		10	Little things Q_3
		11	Bed is going to fall over Q_1
		12	Only one side on it Q_1, Q_2
		13	Lost one bed Q_3
		14	Dots Q_3
		15	Gone to bed Q_2, Q_4
		16	Cover on. Q_4
		17	Can't see legs and hands. Q_1
		18	No cover Q_4
		19	Laying down Q_4
		20	I forgot Q_2
		21	Bed Q_4
		22	Can't sleep Q_3, Q_4
		23	No sides on bed Q_1, Q_4
		24	Girl in the bed Q_2
		25	Bed too small Q_3, Q_4
		26	Broken Q_2
		27	Bed is flat Q_3
		28	*Can't think* Q_2
		29	Marks on it Q_4
		30	Man sick Q_4
		31	Crooked Q_2, Q_4
		32	Boy sick Q_4
		33	Should be in house Q_4
		34	Wheels are gone (off) Q_1, Q_4
	Hand With Brush		
1	Six fingers Q_1	1	Don't know Q_1, Q_2, Q_3, Q_4
		2	Nothing Q_1, Q_3, Q_4
		3	*Tooth brush bent* Q_2
		4	Brushing teeth. Q_3
		5	No arm Q_1
		6	*(Incorrect)* Wrong Q_1, Q_2, Q_3, Q_4
		7	Should be on his teeth Q_3
		8	Brush wasn't on the bureau (chest) Q_3, Q_4
		9	Getting it under water Q_3
		10	Shirt too long Q_3

TABLE 2 (*continued*)

Correct	Incorrect
	11 It is cut Q_4
	12 Not a collar on it Q_3
	13 No good Q_4
	14 Arm not clear up Q_1, Q_4
	15 Brush turned over Q_1
	16 Man is not on Q_1
	17 Maybe he didn't brush his teeth Q_4
	18 Something's on it Q_2
	19. Too small Q_2, Q_3
	20 Wash teeth Q_3, Q_4
	21 Cleaning teeth Q_4
	22 Holding wrong way Q_2, Q_3
	23 Teeth Q_4
	24 No teeth. Q_4
	25 No head Q_2
	26 Handle is crooked Q_1, Q_2
	27 Tooth paste Q_1
	28 One nail is gone Q_1
	29 Not brushing teeth Q_2, Q_4
	30 No other hand Q_2
	31 Where is arm? Q_1
	32 Brush Q_2
	33. Tooth brush broken Q_3, Q_4
	34 Brush in hand. Q_1, Q_4
	35 Washes in it Q_3
	36 Too big Q_4
	37 Not like real hand Q_1
	38 Sore hand. Q_3
	39 Fingers off Q_3
	40. Combing or brushing hair Q_3, Q_4

C DISCUSSION

The clear-cut relationships between facility in the use of language and intelligence, which the writer had presumed to exist, are not demonstrated Nevertheless, though decisive conclusions are not warranted by these data, a "facileness" is more in evidence in the Q_4 answers than in the Q_1 responses, and more cumbersome and clumsy phrasing appears in the answers given by the subjects whose total score ranks them in the lowest quartile. An inspection of Table 2, as a whole, bears out this statement. It is apparent that some of the answers by Q_4 children are not good examples of the skillful use of language—many are decidedly unskillful—but almost no skillfully worded responses are made by Q_1 children

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SHORT ARTICLES AND NOTES

The Journal of Genetic Psychology, 1941, 58, 419-421

A SIMPLE METHOD FOR DEVELOPING OLFACTORY DISCRIMINATION HABITS IN RATS*

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The use of zinc sulphate to immunize monkeys and man against poliomeyelitis has been found to produce temporary anosmia in the majority of subjects if properly administered (3, 4). It is generally believed that this substance modifies the olfactory filaments with which it comes into contact in the olfactory epithelium and that its effectiveness as an immunizing agent may actually be dependent upon their destruction. Our attempts to reproduce the phenomena of anosmia in albino rats with zinc sulphate were unsuccessful, they did, however, impress upon us the need of a simple technique for setting up olfactory discrimination habits. The methods used by Vincent (6), Liggett (2), Swann (5), and Brown and Ghiselli (1) are either more elaborate or less direct than one would wish for simple qualitative studies. Recently my students and I have tried out several methods of setting up olfactory discrimination habits in rats. Although none of these is all that one would wish from the standpoint of directness, simplicity, time saving, and dependability, the method herein described has sufficient merit to warrant brief description.

Essentially the method consists of requiring a hungry rat to differentiate a familiar mixture of moist food from a similar mixture to which has been added quinine sulphate to make it unpalatable and a mild perfume such as white rose, lily of the valley, hyacinth, etc., to make it easily recognized. A teaspoon full of powdered quinine is mixed with 300 grams of dry food (Steenbock mixture) and

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*Received in the Editorial Office on December 16, 1939.

from three to four drops of the synthetic perfumes sold in ten-cent stores is added to this mixture to give it a flowery odor.

Adult animals to be trained are deprived of food for approximately 48 hours before the first test and for 24 hours thereafter Small glass dessert dishes, obtained in quantity from a ten-cent store, are used as containers for the palatable and the unpalatable food Four of these are used at one time, one containing the palatable food and the other three the unpalatable food. The surfaces of the food and the quantity in each dish provide no visual cues by means of which the good food may be recognized. One dish is put into each corner of the animal's living cage (wire mesh cage, with floor dimensions of 16 x 18 inches). All animals except the one to be tested have been temporarily removed With the dishes in place the hungry animal is allowed a three-minute period to explore and to sample these foods At the end of three minutes, the dishes are quickly removed and other food dishes of similar makeup are put in their places After each period the palatable food is put into a different corner in order that the animal will have to search for it As a rule five of the three-minute periods are allowed each day. This gives sufficient eating time to enable an animal to maintain itself from day to day without supplementary diet The essential records to be kept are the instances of eating from the palatable and the unpalatable food dishes during the three-minute periods Mere approaches to, or passing by, food dishes are equivocal for interpretation

A few animals required from four to five days of experience with the food dishes before they could be depended on to make long runs of errorless choices, the majority, however, seldom made an error after the second day of testing (observations limited to 25 animals during a 30-day period) Animals with eyes removed showed no handicap in forming the olfactory habits under the conditions jus outlined Those with olfactory bulbs removed, however, could no form the discrimination habit (10 cases, 30 days of testing) Those in which stable habits had been established lost them immediatel after complete destruction of the olfactory bulbs (10 cases) and failed to regain them again during 30 days of testing

The foregoing simple method can be recommended only for crud qualitative studies of olfactory discrimination, such for example, a testing for anosmia in animals that have been operated to destro the olfactory bulbs, when knowledge of complete anosmia is essentia for guidance in further experimentation. The method has one irremediable fault Occasionally an animal will put its snout over the food dish without actually taking a bite; in such cases the experimenter may be in doubt as to whether the rat has tasted the food by touching its surface with the tip of the tongue Such instances are rare in our records, however, and subsequent observations usually leave no doubt as to whether the animal in question can differentiate the foods on the basis of the olfactory cue alone A method which obviates this fault is described in a note by R. L. French[1]

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The Journal of Genetic Psychology, 1941, 58, 423-424

NOTE CONCERNING THE PROCEDURE EMPLOYED IN INVESTIGATING CHILD ANIMISM*

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In the *Journal of Genetic Psychology*, 1939, 55, 389-400, there appeared a paper by the authors describing a *Standardized Procedure for the Investigation of Animism.* It was pointed out that this procedure makes it possible to classify children into the four stages of animism outlined by Piaget and, by so doing, permits an objective study of factors associated with the development of animism

By way of establishing rapport immediately preceding the examination of the subject by this method the following preliminary remarks are made

> We are going to play a game I am going to ask you some questions and we will see how many you can answer You know what 'living' means? A cat is living but if an automobile runs over it, it is dead

This leads immediately into the presentation of the test objects and the questions concerning them.

In order to determine whether or not these instructions are suggestive, 92 children were examined without the use of any preliminary remarks The subjects were first to fifth grade students in a small-town school in Virginia All were white in race The experimentation was conducted jointly by the two authors with the cooperation of the school officials and was completed in one school day All parts of the procedure were adhered to with the exception that the preliminary remarks were omitted as noted above.

The responses were found to be indentical with those given when the preliminary remarks were employed The only difference between the responses in the two situations lay in the fact that replies to questions following the preliminary remarks were given with more rapidity and more freedom than when these remarks were omitted

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*Received in the Editorial Office on January 20, 1940

This difference was apparent only at the beginning of the examination however, and soon disappeared

These results indicate that the use of the preliminary remarks is not suggestive in itself but, rather, serves as an aid in acquainting the subject with the nature of the questions to follow

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The Journal of Genetic Psychology, 1941, 58, 425-426

EYE-CLOSURE FACILITY AND EYE DOMINANCE*

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When one sights, as in looking through a microscope or shooting a gun, he is likely to close one eye and sight with the other unless he has been taught to do otherwise. It has been thought that facility of eye closure behavior would be related to ocular dominance and visual acuity.

Cuff (1) found in a group of right-eyed children that 41 per cent closed the right eye and that 59 per cent closed the left eye. Danielson (2) concluded that "the general rule is warranted then that the dominance is usually opposite the winking eye." His data indicate however that only 46.20 per cent of his right-eyed subjects closed the left eye. Downey (3) found little relationship between eye closure behavior and eye dominance.

The data reported in this paper were collected from children on whom we had information relative to both the eye preferred in sighting and the relative visual acuity of the two eyes. The ages ranged from five to twelve inclusive.

In the eye closure test the subject was asked to close one of his eyes. After making this observation the subject was asked to open his eye and to close the other eye. The examiner endeavored to determine by the facial contortions manifested by the subject which eye was the more difficult to close. In case of doubt the subject was asked to tell which he thought was the harder to close. If these observations were not satisfactory the subject was told to close both eyes. After a moment he was asked to open only one of them. In this observation we assumed he would open the one ordinarily the harder to close.

One year later these observations were repeated on 113 of the children. In 59.29 per cent of the cases the same findings were recorded. In six sighting tests of eye dominance we have found percentages of agreement on repeating the tests ranging from 80 per cent to 87 per cent. The eye closure test therefore is relatively undependable if considered as a test of eye dominance. This lack of

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*Received in the Editorial Office on February 1, 1940.

dependability may be due to the fact that eye closure behavior is not stabilized at the age levels investigated or due to the subjective nature of the observations.

We have compared our findings on eye closure behavior with results from a sighting test of eye dominance. The sighting test is a ring molded from a pipe cleaner and is about the size of a 50-cent piece. It is attached to a wooden handle which the subject holds at arm's length while sighting. Each subject sighted twice and when repeated for dependability showed the same results in 84 per cent of the cases.

Of the 329 subjects who sighted with the right eye on the ring test 73 per cent closed the left eye more easily and 27 per cent closed the right eye more easily. In other words, using the ring test as a criterion of right eyedness the eye closure test would be inaccurate in about a fourth of the cases.

Of the 170 subjects who sighted with the left eye on the ring test 62 per cent closed the right eye more easily. Using the ring as a criterion of left eyedness the eye closure test as an indication of eyedness would be in error in about one-half of the cases.

We have data also on 57 subjects who had taken the eye-closure test and who had, according to the Snellen chart, a difference in the visual acuity of the two eyes. Our data show that of the 31 subjects who saw better with the right eye only 67.74 per cent closed the left eye more easily. In the case of 26 subjects with higher visual acuity in the left eye only 38.46 per cent closed the right eye more easily.

There is some relationship in our data between eye closure facility and eye dominance as well as between eye closure facility and visual acuity. But the relationship is not sufficiently high to warrant substituting eye closure facility for a sighting test of eye dominance. Nor can we assume which would be the eye with the greater visual acuity from an observation of eye closure facility.

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The Journal of Genetic Psychology, 1941, 58, 427-430

INTERCORRELATIONS AMONG LEARNING ABILITIES III. THE EFFECT OF LENGTH OF TESTS UPON INTERCORRELATIONS*

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In the first study in this series (6) we reported 91 intercorrelations among 13 tests of learning and memory. The median coefficient was + .13, which led us to the conclusion that learning was not a single function, but rather existed in the plural. There are at least several, perhaps many, learning abilities. In the second article, Clyde H. Coombs and the writer (3) presented factorial analysis of this original table. In spite of the low range of correlations, at least four more or less general factors presented themselves. In addition there may be a number of special abilities.

In spite of the usual compulsion toward scientific objectivity, the writer and various others who have worked in this field (1, 2, 4, 5) have seemed uniformly to be surprised at the poor agreement among learning measures. This contrasts with intelligence, where the several sub-tests in a battery show fairly good agreement with the total score. Learning is generally considered nearly as complex a function as intelligence, so we should expect a good degree of transfer of ability from one task of acquisition to another.

Apart from the inter-relationships actually being truly and validly not far above zero, there may be several factors which would account for the poor agreements found. Hall (5) has pointed these out in some detail in an excellent critical article. One of the most important, and the one which we have attacked in the present study, is the length of test. When one administers quite a number of tests to a group of subjects, there are bound to be limitations of time on the part of the experimenter, and of patience and motivation on the part of the subjects. Accordingly there is a temptation to shorten the tests to a degree which will reduce reliability to an extent where chance factors play too large a part. In our case, although subjects

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*Received in the Editorial Office on February 12, 1940.

served in the first study for three one-hour periods, it must be admitted that some of the tests were shorter than might ideally have been desirable. To check this possibility the present study was undertaken.

In the fourth article another possibility—that of a narrow range of talent—is being checked. College students are so close together in intelligence, and possible in learning capacity likewise, that correlations are necessarily lowered.

TECHNIQUE

We chose six tests from the 17 administered (four were tests of memory, so learning scores could not be taken, hence the permutations among the 13 scores) in the first study (6), and in general increased these to four times their original length. Such a procedure should not only provide increased reliability in terms of a greater accumulation of statistics, but also furnish greater index of ultimate skill. The tests used are listed in Table 1.

TABLE 1
ORDER OF TESTS USED

		Class*	Time
	First day		
1	Maze learning, to perfection	II	15
2	Spool packing, 20 trials	I	25
3	Pursuit rotor, 20 trials	I	15
	Total	55 min	
	Second day		
4	Code substitution, 20 trials	II	30
5	Mirror drawing, 20 trials	I	20
6	Incidental memory for code	II	5
	Total	55 min	

*I. Motor tests
II. Rote learning tests

In establishing the test order we kept in mind the following considerations: successive tests were varied in nature, to minimize either positive or negative transfer; retroactive inhibition was avoided; and tests requiring greater degrees of concentration were separated by somewhat easier ones.

The subjects were 80 college students, all taken from the Psychology I course, hence totally without laboratory experience. All students in the course were required to take part in some investigation, so our selection should be representative of second and third year college students They each served two hours, spaced a week apart Testing was entirely individual.

RESULTS

Our major results are contained in Table 2 in the form of the intercorrelations obtained among the six tests.

TABLE 2

INTERCORRELATIONS AMONG LEARNING TESTS

	Spool packing	*Pursuit* rotor	*Code* substitution	*Mirror* drawing	*Incidental* memory
Maze	—32	06	25	14	29
Spool packing		.05	.17	28	30
Pursuit rotor			21	20	07
Code				26	23
Mirror drawing					03

The most striking finding again is the exceedingly low range of coefficients The median is + .20, although with just 15 coefficients *this is possibly not to be taken as entirely final. This figure is a* trifle higher than the median for the original series, but so little higher that one would hesitate to suggest that quadrupling the length of test had produced any material differences

As discussed previously, the scores to use in computing the correlations is open to argument We finally chose to use total scores of all trials, on the assumption that improvement would be represented by low scores on later trials, hence lower totals Using scores on the first few and last few trials would be unsatisfactory, as gross gain scores would favor those who did badly initially, and unduly handicap the person who started well, and who was too close to a possible physiological limit. Total scores, while perhaps not desirable from all angles, give due credit both to initial adaptation and to subsequent gains

SUMMARY

1 This study is the third in a series investigating the intercorrelations among learning abilities The purpose of this particular experiment is to study the influence of length of test upon intercorrelations, on the theoretical possibility that in the first investigation in this series the tests might have been too short to furnish adequate reliability

2. Eighty college students were put through six learning tests, in the main a total of 20 trials. This took two one-hour periods, a week apart.

3. The median intercorrelation obtained was + 20, as compared with one of + 13 in the original study. Since this is in the same general inconsequential range, it appears that the length of the test does not influence to any material extent the agreement among learning measures.

4. Therefore, pending the testing of other possible factors, our original conclusion that learning abilities are more specific than general still stands.

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The Journal of Genetic Psychology, 1941, 58, 431-434

INTERCORRELATIONS AMONG LEARNING ABILITIES: IV. EFFECTS OF AGE AND SPREAD OF INTELLIGENCE UPON RELATIONSHIPS*

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It has been suggested (1, 2) that one reason for the extremely low intercorrelations obtained between different measures of learning may be the fact that most tests have been run on college students, who represent a homogeneous population, especially in terms of intelligence, but also of age and education.

A narrow range of talent operates to reduce any correlation coefficient since the differences in sheer ability are so small that slight differences in experience, chancing on an efficient mode of attack, personality factors such as perseverance, enthusiasm, conscientiousness, and even luck, can alter very materially one's position within his group If the spread of abilities happens to be wider, such minor factors cannot make up for discrepancies in true ability

Since a university group will almost always show the great majority of subjects to fall within about a 15 point range in *IQ*, from 105 to 120, it appeared that it would be necessary to sample younger subjects from a public school Since selection in education begins as early as the grades, it is clear that the younger our subjects could be the more we would avoid the difficulty of narrow range of talent At the same time many learning tests cannot be applied at all below certain ages, or must be so shortened and/or simplified that they lose reliability and validity

So, everything considered, it seemed best to choose junior high school pupils as our subjects Wisconsin state school laws necessitate virtually everyone still being in school in these grades, so our selection was practically random We were fortunate in being able to secure approximately 30 pupils each from two of the junior high schools in Madison, one the university operated school, patronized chiefly by children of professional families, and the other a school located closer to the business and industrial districts The total *IQ*

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*Received in the Editorial Office on February 12, 1940

range was from 81 to 162, with a median of 106.5. The children were in the seventh and eighth grades, and had an age range of 11½ to 16½ with a median of 15[1]

PROCEDURE

The tests used were chosen from the lengthy battery administered *in the first study in this series*, as being ones which were especially suited for junior high school students. The nature of the tasks should be relatively easy to comprehend and perform, and of such nature that they could be shortened where necessary for younger subjects. As such, the tests chosen for our use were those listed in Table 1. The tests were given on two separate days, usually two days apart, at the same time of day, the subjects being drawn from study hall periods.

TABLE 1

ORDER OF TESTS USED

First day

1 Code substitution (five sheets of 40 letters each)
2 Spool packing (five trials of five trays each)
3 Mirror drawing (three stars)

Second day

4 Maze learning (six turns of an elevated finger maze)
5 Reading comprehension (four typed pages of geographical material, 10 minutes to read as compared with 6½ for college students; test of retention after Test 6)
6 Mental maze (eight pairs of numbers, one being correct in each pair)

RESULTS

The main results of this study are contained in Table 2, the table of intercorrelations.

The median correlation of the 15 coefficients presented is +.10, which of course is virtually insignificant. We may compare this figure with those of +.13 found in the first general study, and +.19 where the series was lengthened. The conclusion again is that learning abilities are specific.

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[1] The writer wishes to acknowledge the work of Miss Margaret Harper and Miss Marian Knapp, also to thank Superintendent Falk, Principals McKenzie and Waehler, and Instructor Diehl, for securing the subjects for us from their schools and classes.

TABLE 2

INTERCORRELATIONS AMONG LEARNING TASKS, AND WITH INTELLIGENCE

	Code	Spool packing	Mirror drawing	Maze	Reading	Mental maze
IQ	17	—30	22	38	.52	34
Code		.33	—04	09	26	01
Spool packing			09	14	08	—27
Mirror drawing				35	04	09
Maze					18	37
Reading						10

It might have been possible that in the present study a higher range of intelligence would have produced a greater differentiation among subjects of different degrees of innate ability, which would have meant that even if learning and aptitude were not perfectly correlated, at the same time the best learners might have been above average in all performances, and the poorer students below average But such was not the case.

Actually, some of the highest correlations appeared between learning tasks and intelligence The highest single coefficient was between ideational memory for the reading passage and intelligence, + 52, this may be said to have run true to form The next highest figure was that between scholastic aptitude and the mental maze, again not surprising Correlations involving the more motor tasks, either among each other or between themselves and complex learning or intelligence, in general ranged much lower

Other factors which might be suggested as productive of divergent influences are probably of minor importance And as a matter of fact they probably would serve to raise rather than to lower the correlations We have in mind such factors as motivation, scholastic interest, or socio-economic background From general observation it would probably be agreed that those of lesser intelligence would be less likely to try hard and would be less adapted to an experimental situation than would those of greater scholastic ability Such influences would serve to spread rather than to concentrate the group, and if they worked systematically should produce higher rather than lower correlations

SUMMARY

1 To check one aspect of the problem of possible correlations

among learning abilities, that of range of aptitude, 53 junior high school children were measured on six learning tests The tests varied among motor, rote, and ideational tasks, and occupied two one-hour sessions

2 The median intercorrelation turned out to be + 10. Since the group had a wide range of intelligence, *IQ*'s being from 81 to 162, this check experiment serves to corroborate the results found in two previous studies

3. We may conclude, therefore, with even more certainty than before, that learning abilities are specific rather than general.

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The Journal of Genetic Psychology, 1941, 58, 435-439

AN EXPERIMENTAL STUDY OF EARLY CHILDHOOD MEMORY FINAL REPORT*

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The present study is a continuation of one reported earlier (1, 2) in which nonsense material presented systematically to the subject in infancy, was re-learned at a later age and the rate of re-learning compared with the rate of learning new material of similar nature. The previously reported re-learning experiments began at the ages of 8½ and 14 respectively, the present one at the age of 18. The material consisted of selections from Sophocles *Oedipus Tyrannus* in the original Greek which was tantamount to nonsense material. Each selection included approximately 20 lines or 240 syllables of iambic hexameter. The subject was a boy with an *IQ* of approximately 130. Beginning at the age of 15 months three of these selections were read to him once daily for a period of three months—a total of 90 repetitions. At the age of 18 months these selections were discontinued and three others read daily for three months. This procedure was continued until the subject was three years old and 21 selections had been presented. The 8½ year experiment utilized one-third (seven selections,—one from each 3-month period) of the available material which had been presented in infancy plus three new selections for control. The 14-year experiment utilized another third, and the present and final experiment used the last seven selections plus three new controls. It was thus possible to compare the "saving" at the three ages.

The procedure in the present case was practically identical with that in the previous experiments. Two trials were given daily and this schedule was maintained with very little variation. A minor difference was the re-learning of two selections which had served as controls in the two previous series. The 12 selections under comparison were always given in one trial and their order from trial to trial was rotated systematically. The selections as in the earlier experiment, were merely read to the subject for the first 18 trials

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*Received in the Editorial Office on February 26, 1940

Beginning with the nineteenth, every third trial used the prompting method in which the selection was read slowly and the subject anticipated any syllables which he could. These syllables were underlined in the text and the date noted at which they had first been anticipated correctly. This procedure was continued until every syllable in a selecton, except for the initial cue words, had been *anticipated and the requisite number of trials* constituted one item of score. The repetitions were continued as necessary until the subject could recite the entire selection without prompting and the number of trials up to this point constituted the other item of score. Motivation in the present instance was apparently about the same as in the second experiment. A variable which could not be controlled, of course, was the occasional tendency to think of words or phrases between trials. This was marked with reference to Selection *D* (infra) but otherwise the tendency was negligible. In a few instances while listening to a selection when he was not supposed to recite, the subject did speak it softly to himself. On the occasions when there was an apparent tendency to depart from the regular program in the way of reciting between trials, no comment was made and the practice seldom persisted. With the exception of Selections *A* and *D*, which had served as controls in the two earlier series, the subject apparently had no notion as to which were original *and which were control selections.*

The main results together with some data from the earlier experiment by way of comparison are given in Table 1. The first column gives the age at which the original reading took place. The Roman numerals in the next column are the arbitrary designations of the selections used in the 8-year experiment. The next column gives the number of repetitions necessary before the subject recited the selection verbatim without prompting. The data were analyzed from two standpoints, the number of repetitions necessary before each word in the selection had been anticipated and the number of repetitions required for reciting it verbatim without prompting. Previous analysis indicated, however, that there was little choice between these two methods of scoring and for the remainder of the discussion the data will be confined to the last method, viz., the number of trials necessary for a complete verbatim recital without prompting. Such scores for the 8-year experiment occur in the third column. *The next two columns give similar data for the* 14-

TABLE 1
TRIALS NECESSARY FOR CORRECT RECITATION

Age in mos. at original reading	Eight year selection	Trials	Fourteen year selection	Trials	Eighteen year selection	Trials
15-18	III	382	II	142	I	202
18-21	VI	253	V	139	IV	190
21-24	IX	385	VIII	169	VII	181
24-27	XII	379	XI	151	X	220
27-30	XV	328	XIV	145	XIII	160
30-33	XVIII	226	XVII	169	XVI	175
33-36	XXI	265	XX	127	XIX	193
Av of all		317		149		189
Av 3 early		340		150		191
Av 4 later		299		148		187
Control	*A*	409	*D*	169	*G*	205
	B	451	*E*	151	*H*	193
	C	445	*F*	166	*J*	175
Av control		435		162		191
					A	112
					D	37

year experiment and the last two columns for the present experiment. The lower portion of the table gives data for the control selections, i.e., those which were learned de novo. These were arbitrarily designated by letters rather than by Roman numerals. In the last two columns Selections *A* and *D* appear a second time. They were *included at the 18-year level to determine the difficulty* of relearning a selection of this type which had been mastered ten or four years previously.

The most general notion of the results may be obtained from the averages. It required 189 repetitions for a correct recital of the average selection in the present re-learning experiment whereas for the corresponding control selections the average is 191. The difference obviously is negligible and of no statistical significance. By the other method of scoring (supra—not shown in table) the corresponding averages are 172 and 175. The absence of any saving in the present case may be compared with the 27 per cent at 8 years (30 per cent by the other method of scoring—supra) and 8 per cent at 14 years by either scoring method. *Apparently the last four years* were sufficient to eradicate completely any trace of the original stimulation in infancy.

As in the previous experiments, the selections were grouped and averaged so that the three which were presented earliest in infancy constituted one group and the four in later infancy a second group The difference between these averages obviously is not significant in the present series

Learning curves were plotted as in the previous series (2). The two curves for average relearning selection and average control selection are practically indistinguishable and not worth presenting here

The gross number of repetitions necessary in the present study was much less than in the 8-year but slightly greater than in the 14-year experiment The former difference is presumably due to greater maturity, better motivation and an appreciation of the scientific importance of the experiment The reason for the latter is less clear. It cannot be attributed to the mere lapse of time since the reading in infancy, because it characterized control as well as experimental selections The subject reported occasional confusion of groups of syllables with similar groups which he remembered vaguely It is quite possible that such similar groups were carried over from the 14-year experiment and caused this confusion Indications of this carry-over may be seen in the fact that Selection *D* which had been learned to the point of complete recitation at age 14 was relearned at age 18 in 37 repetitions, and on the 19th trial which was the first one on which he was allowed to attempt recitation the subject repeated 182 out of the 240 syllables Incidentally on the second trial with that selection the subject stated that it sounded familiar and thereafter was suspicious that he had experienced it more recently than infancy. However quite early with Selection *G* (control) he stated that some words were vaguely familiar.

On the whole the experiment suggests that the effect of presenting nonsense material in infancy was very clearly manifest in relearning experiments at the age of 8½, traces were still apparent at the age of 14, but by the age of 18 the effect had completely disappeared

SUMMARY

Meaningless material (20-line selections of Greek drama) was read aloud to the subject daily beginning at the age of 15 months Every three months a different set of similar selections was used as material and this procedure was continued till the age of three

The Journal of Genetic Psychology, 1941, 58, 441-452.

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Rosett, J. The *Mechanism of Thought, Imagery, and Hallucination.* New York Columbia Univ Press, 1939 Pp. 289

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CRITICAL REVIEWS OF RECENT BOOKS

(*Goldstein, K Human Nature in the Light of Psychopathology Cambridge: Harvard Univ. Press, 1940. Pp 258*)

REVIEWED BY FREDERICK WYATT

In the William James Lectures delivered at Harvard University in 1937-1938, Goldstein expounds what psychology can learn from the study of persons afflicted with diseases or lesions of the brain At the same time he outlines a system of psychology on a biological basis Goldstein sees as an important turning point in the method of biology, its swinging away from the atomistic, overwhelmingly quantitative approach Instead, the "holistic" approach has been developed during the last two or three decades, to the elaboration of which the author has greatly contributed It rests on the observation that organic processes observed in isolation change their function Every observation has to be made with a view of the entire organism, following the scheme of "figure" and "background" which was introduced by Gestalt Psychology. The value of single facts for the understanding of the organism depends on our concept of the latter and on their significance or biological relevance Any understanding of any single function of the organism can only be accomplished by an interpretation which as a principle considers not only the entire organism as a living unit, but also its developmental history and its environment. The intrinsic structure, the "Gestalt" of the Organism is not discovered piecemeal but is supplied by our own thinking, as one of the "symbols" without which the task of science could not be accomplished "In biology every fact always has a qualitative significance." Explanatory hypotheses, therefore, must be advanced in order to be tested empirically and to be withdrawn or amended, if this should prove to be necessary.

For the study of the human personality Goldstein believes pathological data to be very helpful, those which are derived from diseases or lesions of the brain more so than those from the yet controversial fields of neurosis and psychosis Supported by a rich case-material Goldstein proceeds to demonstrate that persons with brain lesions exhibit behavior which is characteristic through "lack of grasp of the abstract, lack of an approach to imagined things, inability on the part of the patient to give himself an account of his own acting and thinking, inability to make a separation between the ego and the world, and lack of freedom" In Goldstein's opinion all these things mean the same, namely "The lack of an attitude toward the abstract." Patients of this kind show an abnormal degree of dependence on the outer reality. Because of their inability to perform abstractions they are also utterly unproductive Goldstein concludes that in human beings generally two types of behavior can be distinguished, the concrete and the abstract, of which the latter represents the highest and essential capacity of man.

Phenomena which can be observed with patients suffering from aphasia, show that they have lost understanding for the general conceptual meaning of words, a phenomenon which again can be traced back to the loss of the capacity to make any sort of abstraction If strong but inadequate stimuli force themselves upon the organism it feels threatened in its existence so that "catastrophic" reactions will result, as may be observed with patients suffering from brain diseases when faced with tasks with which they cannot cope Such an experience produces anxiety

> Anxiety deals with nothingness. It is the inner experience of being faced with nothingness. Fear is the anticipation of onsetting anxiety

The sick will take to certain mechansims in order to escape fear The normal individual by his desire for expansion and self-actualization will conquer fear through activity and will "come to terms" with the world

Also normal persons want to lessen their anxiety through order, norms, continuity, etc., but this tendency interacts with the desire to expand. Out of the interaction between these two comes the development of culture " courage is nothing but an affirmative answer to the shocks of existence . which are necessary to bear for the sake of realizing one's own nature."

Instinctive actions mean the coming to terms of the organism with the outer world· "they make possible the organism's actualization of its capacities." Goldstein disagrees pointedly with the assumption that there are several basic instincts or drives. In his opinion they may be brought back to the *one* basic tendency of self-actualization which is the essential moving force of the organism

Conscious and non-conscious phenomena in a definite configuration characterize conscious behavior. Sometimes one of them appears as "figure," the rest as "background." But only in scientific abstraction can any one of them be singled out. Neurosis expresses a biological event similar to that which becomes effective in brain diseases. Both are governed by the same fundamental law. The organism has not been able to react in an adequate way to certain stimuli, these particular incidents, therefore, attain an abnormal strength so that they again produce abnormal after effects. The child's inadequacy toward reality leads to catastrophic situations which he tries to avoid by means of substitute reactions and by building up new habits, with the aim to escape anxiety. Because they are isolated from the total personality, these attitudes have a disturbing influence.

Among all the potential ways in which the organism may behave, a number can be observed in which it actually seeks to function. These "preferred performances" correspond best to the capacities of the organism. They amount to constants, or basic traits of the constitutional and character make-up of the individual. These modes of preferred behavior, again, exercise a selecting and accentuating influence on his manner of coping with new experiences.

The actualization of the self which Goldstein contends is the only moving force of human activity, expresses itself in social life through two forms of behavior: self-restriction and encroachment upon other persons. The individual is considered primary to society though he is moulded by a convergence of external and internal factors. The customs of the social environment are taken on by the individual in his youth. They belong to the group but their transmission depends on the ability for abstractive attitudes, which is peculiar to the individual.

Goldstein has well demonstrated how much psychology can gain from an observation of the defective organism, in this case, from disease or lesion of the brain. It remains open to question, however, whether generalizations derived from his field can be extended to the entire breadth of individual and social psychology. In the explanation of the "catastrophic situations" there seems to exist some logical incongruity in the equation of one statement, which indicates that "the source of anxiety is nothing and nowhere" (non-existence of source), with the other, that it is "the inner experience of being faced with nothingness (*threat of annihilation*) It would seem, too, that two essentially different experiences such as the feebleness of the child in respect to the stimuli of its environment (in general, but more from the physical point of view), and the conflict which arises between the child's "tendency toward self-realization" and the demand of the (human, psychological) environment, cannot be made into one

Goldstein has in an admirable way implemented in his discourse the findings and ideas of scientists of widely differing convictions To Freud's work, however, though discussing it at some length, he has done little justice. With regard to the fundamentals of Goldstein's psychology, it would seem that the "attitude toward the abstract" as the *main principle of mental life is overstrained*, significant though it certainly is The same applies to the "desire for self actualization" which as a principle is too indefinite to be of great explanatory power. There is, particularly in the latter idea, a touch of metaphysics which would seem to go beyond what Goldstein himself suggests as the proper range of a "symbol"

The concept of the organism itself one would wish more accurately defined. It is not always clear whether this term means the entire organic unit of the individual, or only the body But the criticism of certain factual positions as, for instance, that of instincts or that of fear, should not obscure the merits of this book which is particularly constructive from the methodological and philosophical point of view. The systematic criticism of atomism in biology, of the stimulus response scheme, and of conditioned reflexes puts theoretical elaboration and the weight of large experience to the support of a trend in modern biology and bio-psychology which strikes me as of profound importance. The implementation of comprehensive hypotheses, the characterization of the nature of data in biology, the outline of a methodology of the biological sciences are contributions of great value. A methodological discussion and survey of the psychological insight which may be derived from the study of brain diseases and lesions has been wanting for some time, and it gains through the fact that Goldstein is reporting about research of which he himself has conducted a substantial part Nor should the ethical conviction with which this book is imbued remain without appeal.

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(Katona, G. Organizing and Memorizing. New York: Columbia Univ. Press, 1940. Pp. 318.)

Reviewed by Livingston Welch

These studies in the psychology of learning and teaching are based on the distinction between meaningful and senseless learning. The first type involves the establishment of connections "by the conditioned reflex technique or by repeating the same contents or responses over and over again." The second entails "apprehension of relations," "understanding of a procedure," and "insight into a situation." In looser language, the former is sometimes referred to as memorizing and the latter as understanding.

The major thesis which Dr. Katona endeavors to support is that understanding organized wholes is the prototype of learning. He challenges the assumption that this is true of mechanical memorization. His challenge is made with caution, for while he stresses many of the essential differences between these two processes, he admits that as yet proof is insufficient concerning the existence of any priority of memory, or that memory and understanding are distinct and independent learning processes. "So far," he adds, "we have failed to prove explicitly that the understanding of a meaningful whole is not the result of many arbitrary connections previously formed."

He demonstrates the advantage of both processes, but expresses the belief that those of understanding are more significant. His analysis of the two processes is based on experimental investigations made on college students who were given problems consisting of required changes in designs made with matches, and card tricks. Those subjects who learned the principle involved in the first of these two types of tasks were much more successful in generalizing with similar problems. The results, however, indicate that memorization is "in some cases the quickest way of learning," it often brings the shortest reaction time, and is certainly better than incorrect or partial understanding. These are cases where the application of knowledge is not required.

The author attempts to explain why meaningful learning, or understanding, is advantageous to generalization or transfer by aid of a hypothesis of memory traces. This hypothesis includes the distinction between structural and individual traces The structural traces are not vague ideas As carriers of knowledge they are as clear as individual traces But the structural traces are flexible and adaptable to situations, whereas the individual traces are not

"Just as a perception can be called a unified, centered and condensed result of the stimuli," he says, "a structural trace can be called a unified and condensed result of a perception"

Individual traces are not formed by sudden insight, or gradually by an adequate organization of a material, but "are the results of a slow, patient and laborious method—memorizing"

His memory trace theory is used to explain the underlying differences between memory learning and understanding, since the former makes use of individual traces and the latter of structural traces. Unfortunately, his description of traces, at one point at least, results in circular argumentation, for he explains memory in terms of individual traces, and individual traces as the result of memorizing.

The most important contributions of this work are the results of his experimental studies, and the description of the differences between the two processes in question. Whatever we may call them, or however we may interpret them, several processes of some sort exist in learning On a wider scale, the ultimate explanation of the similarities and differences between the conditioning, the trial and error, the "insight" and the inductive reasoning situations, still remain to be given satisfactorily. Can these be distinguished in terms of memory and understanding alone, or in terms of varying degrees of applicability? Such questions extend beyond the limits of Dr. Katona's present inquiry Still his investigations and speculations are closely related to this larger problem He has shown cases where the understanding process is superior to the memory process, and vice versa He has admitted that often learning may be a gradual process, that insight does not necessarily occur at once, and that there may be an interdependence between memorizing and understanding. From this point we may proceed farther, and admit that (*a*) there is no necessity for assuming all learning to be of one type, (*b*) that the great diversity of problem situations requires essentially different methods of discovering solutions. The cat in a problem box has very little opportunity of making use of Pavlovian conditioning. If Pavlov's dog had a human brain he might have amused himself by making inductions But it is inconceivable how he could have indulged in trial and error, or insight, in such a situation Any one can widen or limit the application of the term learning, but this does not alter human behavior, nor decrease the variety of problem situations Though Dr. Katona's interpretations are based on the principles of the Gestalt School, he has, either intentionally or unintentionally, implied many propositions that would break down barriers between his school and others.

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